

## REGIONAL INFORMATION REPORT NO. 5J90-03



### Preliminary Forecasts and Projections for 1990 Alaska Salmon Fisheries

Edited by:

Harold J. Geiger

and

Herman Savikko

February 1990

# PRELIMINARY FORECASTS AND PROJECTIONS FOR 1990 ALASKA SALMON FISHERIES

Edited by:

Harold J. Geiger  
Biometrician

and

Herman Savikko  
Fishery Biologist

REGIONAL INFORMATION REPORT<sup>1</sup> NO. 5J90-03

Alaska Department of Fish and Game  
Division of Commercial Fisheries  
P.O. Box 3-2000  
Juneau, Alaska 99802-2000

February 1990

---

<sup>1</sup> The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

## **AUTHORS**

Harold J. Geiger is the Statewide Salmon Biometrician for the Alaska Department of Fish and Game, Division of Commercial Fisheries, P.O. Box 3-2000, Juneau, AK 99802.

Herman Savikko is a Fishery Biologist for the Alaska Department of Fish and Game, Division of Commercial Fisheries, P.O. Box 3-2000, Juneau, AK 99802.

## **ACKNOWLEDGMENTS**

This report is based on information contributed by Division of Commercial Fisheries biologists located in field offices throughout the state. Area biologists, not individually identified, supplied reviews of the 1989 fishing season. Individual credit for forecast material goes to the area forecast discussions in the Appendices.

## TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES . . . . .	iv
LIST OF FIGURES . . . . .	v
LIST OF APPENDICES . . . . .	vi
ABSTRACT . . . . .	vii
INTRODUCTION . . . . .	1
PRELIMINARY REVIEW OF THE 1989 ALASKA COMMERCIAL SALMON FISHERY . . .	12
Southeast Region . . . . .	19
Central Region . . . . .	20
Arctic-Yukon-Kuskokwim Region . . . . .	25
Westward Region . . . . .	28
PRELIMINARY FORECASTS OF 1990 SALMON RETURNS TO SELECTED ALASKA FISHERIES . . . . .	33
OUTLOOK FOR THE 1990 ALASKA COMMERCIAL SALMON HARVESTS . . . . .	36
Species Outlook . . . . .	36
LITERATURE CITED . . . . .	40
APPENDICES . . . . .	42

## LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Forecasted return, harvest, escapement goal, preliminary return, escapement, harvest, management error (i.e., difference between realized escapement and escapement goal), and return forecast error for major salmon fisheries where formal forecasts were made, 1970-1989. Projected and realized Alaska commercial salmon harvests with absolute and relative error, 1970-1989 . . . . .	3 3
2. Comparison of actual and forecast 1989 salmon runs, with errors and relative errors, for some major Alaska salmon fisheries . . . . .	13
3. Preliminary 1989 Alaska commercial salmon harvest by species and fishing area . . . . .	14
4. Preliminary 1989 Southeast Alaska commercial salmon harvest by species and management area . . . . .	15
5. Preliminary 1989 Central Region Alaska commercial salmon harvest by species and management area . . . . .	16
6. Preliminary 1989 Westward Region Alaska commercial salmon harvest by species and management area . . . . .	17
7. Preliminary 1989 Arctic-Yukon-Kuskokwim Region Alaska commercial salmon harvest by species and management area . . . .	18
8. Preliminary forecasts of salmon runs and commercial and hatchery cost recovery of some Alaska fisheries in 1990 . . . .	34
9. Preliminary projections of 1990 Alaska commercial salmon harvests by statistical region and species in thousands of fish . . . . .	37
10. Preliminary projections of 1990 Alaska commercial salmon harvests by fishing area and species in thousands of fish . . .	38

## LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. The 3 statistical regions (Western, Central, Southeastern) and the 4 fisheries regions (Westward, A-Y-K, Central, Southeastern) of the Alaska Department of Fish and Game, Division of Commercial Fisheries . . . . .	2
2. Relationship between observed return (millions) and forecasted return (millions) for major salmon fisheries with formal forecasts, 1970-1989 . . . . .	4
3. Relationship between actual catch (thousands) and projected catch (thousands) for Alaskan chinook salmon from 1970-1989, with the 1990 projection . . . . .	5
4. Relationship between actual catch (millions) and projected catch (millions) for Alaskan sockeye salmon from 1970-1989, with the 1990 projection. . . . .	6
5. Relationship between actual catch (millions) and projected catch (millions) for Alaskan coho salmon from 1970-1989, with the 1990 projection. . . . .	7
6. Relationship between actual catch (millions) and projected catch (millions) for Alaskan pink salmon from 1970-1989, with the 1990 projection. . . . .	8
7. Relationship between actual catch (millions) and projected catch (millions) for Alaskan chum salmon from 1970-1989, with the 1990 projection. . . . .	9

## LIST OF APPENDICES

	<u>Page</u>
APPENDICES - FORECAST METHODS AND DISCUSSIONS	
APPENDIX A.1 Southeast Alaska Pink Salmon . . . . .	43
APPENDIX A.2 Prince William Sound Pink and Chum Salmon, Coghill River Sockeye Salmon and Prince William Sound Coho Salmon . . . . .	46
APPENDIX A.3 Prince William Sound/Copper River Sockeye and Chinook Salmon . . . . .	57
APPENDIX A.4 Upper Cook Inlet Sockeye Salmon . . . . .	60
APPENDIX A.5 Lower Cook Inlet Sockeye Salmon . . . . .	61
APPENDIX A.6 Kodiak Pink Salmon . . . . .	63
APPENDIX A.7 Kodiak Upper Station Lake, Frazer Lake, and Ayakulik River Sockeye Salmon . . . . .	66
APPENDIX A.8 Chignik Sockeye Salmon . . . . .	71
APPENDIX A.9 Bristol Bay Sockeye Salmon . . . . .	73
APPENDIX A.10 Bristol Bay, Nushagak District, Chinook Salmon . . .	75
APPENDIX B.1. A-Y-K Harvest Outlook by Area . . . . .	76
Appendix Table B.1 Preliminary Projections of the 1990 A-Y-K Commercial Salmon Harvest in Thousands of Fish by Management Area and Species . . . . .	78

## ABSTRACT

The 1989 fishing season produced another record salmon harvest in spite of severe management problems caused by the grounding of the M/V *Exxon Valdez* oil tanker. A preliminary total of 153.3 million salmon were harvested in Alaskan waters. A larger than expected Bristol Bay sockeye salmon harvest, and Southeast Alaska pink salmon harvest were memorable highlights of the 1989 season. The preliminary estimated ex-vessel price paid for this year's harvest was over \$505 million, second only to 1988's record of \$750. Salmon catches are expected to fall in 1990, with a projected harvest of 108.2 million salmon. An expected poor even year return of pink salmon to Southeast Alaska, a lower expected run of sockeye salmon to Bristol Bay, and an expected low wild stock pink salmon return in Prince William Sound are some of the features of the 1990 outlook. The 1990 fishery will no doubt be disrupted by unknown biological and unanticipated management problems stemming from the M/V *Exxon Valdez* oil spill not considered in these forecasts.

KEY WORDS: Salmon, *Oncorhynchus* sp., salmon run forecast, salmon harvest projection



## INTRODUCTION

This report reviews Alaska's 1989 commercial salmon season and presents preliminary salmon run forecasts and harvest projections for the 1990 commercial fisheries. The report is released before final catch figures are available. This release is to provide preliminary information to the Board of Fisheries, the fishing industry, and the public well before the season begins.

Forecasts of runs (catch + escapements) for major salmon fisheries and projections of the statewide commercial salmon harvest have been published yearly by the Alaska Department of Fish and Game since 1969 (ADF&G 1969-1984; Eggers 1985, 1986; Eggers and Dean 1987, 1988; Geiger and Savikko, 1989). In 1989 the Alaska Department of Fish and Game released formal herring forecasts for the first time. Forecasts for other fisheries, such as the shellfish fisheries, will be forthcoming as reliable methods are developed for these species.

The major fishing areas within the Southeast, Central, and Western statistical regions are shown in Figure 1. These regions and areas are the ones used in the Department's statistical leaflet series and prior statistical reports. Ages and brood years for 1990 salmon runs by species are as follows:

Species	Age of Returning Salmon in Years				
	2	3	4	5	6
Pink	1988				
Chum		1987	1986	1985	
Coho		1987	1986		
Sockeye			1986	1985	1984
Chinook			1986	1985	1984

On the average, the run forecasts for the total number of salmon have been close to the actual runs, with the forecast exceeding the run in 6 of the last 20 years (Table 1). The historical performance of the forecasted run to major salmon fisheries during the period 1970-1989 is shown in Figure 2. The historical projected statewide harvest (that is expected catch for all fisheries in the state) has also exceeded the actual harvest 10 out of the last 20 years for chinook salmon, 7 out of the last 20 years for sockeye salmon, 5 out of the last 20 years for coho, 7 out of the last 20 years for pink salmon, and 6 out of the last 20 years for chum salmon. The accuracy of the harvest projections, on a statewide basis are shown for each salmon species in Figure 3 through Figure 7. The common and scientific names for Alaska's Pacific salmon species are as follows:

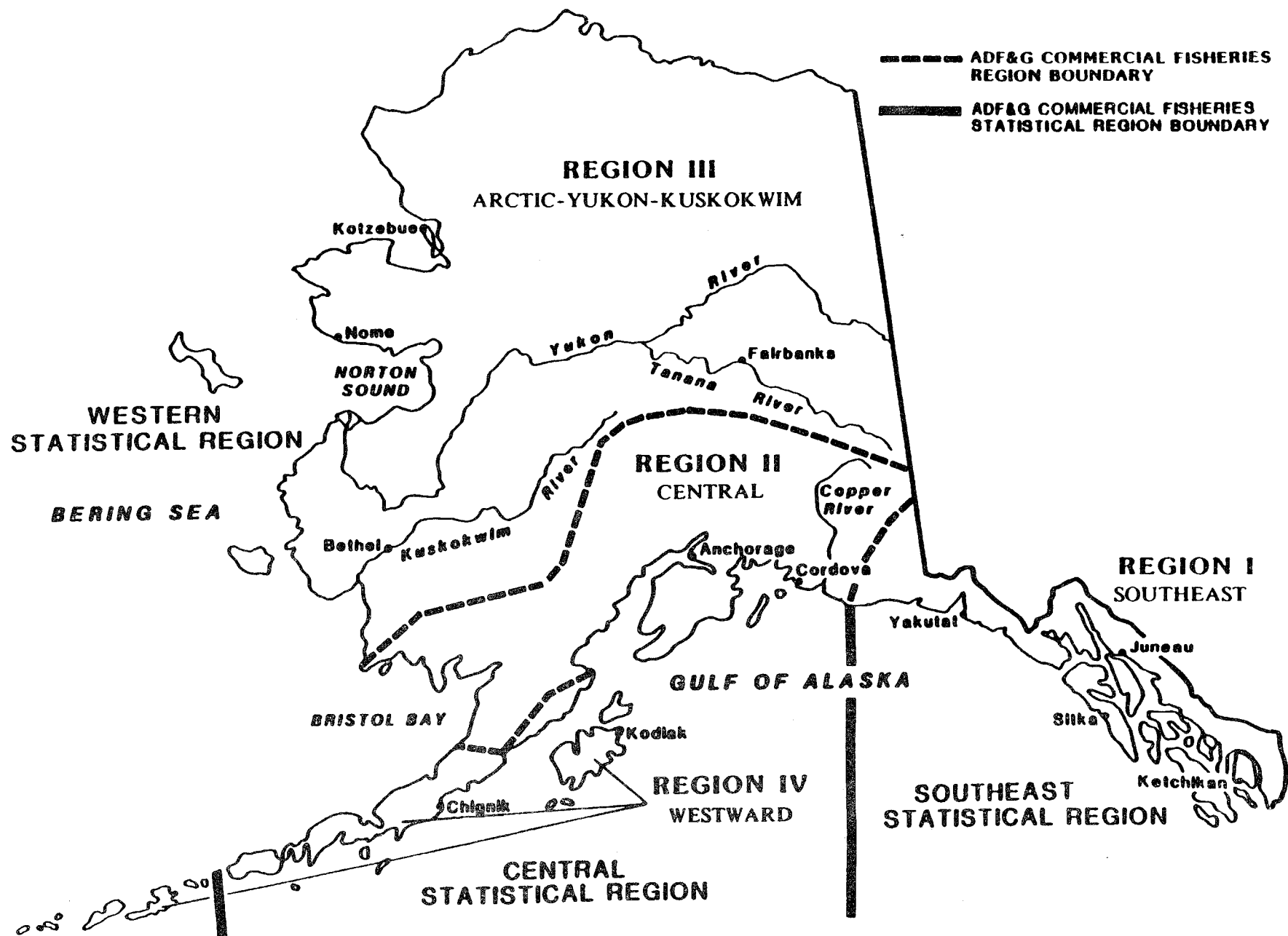


Figure 1. The 3 statistical regions (Western, Central, Southeastern) and the 4 fisheries regions (Westward, A-Y-K, Central, Southeastern) of the Alaska Department of Fish and Game, Division of Commercial Fisheries.

Table 1. Forecasted return, harvest, escapement goal, preliminary return, escapement, harvest, management error (i.e., the difference between realized escapement and escapement goal), and return forecast error for major salmon fisheries where formal forecasts are made, 1970-1989. Projected and realized Alaska commercial salmon harvests with absolute and relative error, 1970-1989. Figures are in thousands of salmon.

	Only Major Fisheries Where Formal Forecasts Are Made										Projected Collective Harvest of all Alaska Salmon Fisheries				Forecasted Harvest Relative to Projected Statewide Harvest %
	Actual (Note Figures Based on Preliminary Data)														
	Forecasted														
Year	Return	Harvest	Escapement Goal	Return	Escapement	Harvest	Management Error a/ (thousands)	%	Forecast Error b/ (thousands)	%	Projected Harvest	Actual Harvest	Error c/ Error d/	Relative Error d/	
1970	114,347	77,080	37,267	64,653	17,271	47,382	19,996	54%	49,694	77%	95,500	68,500	27,000	39%	81%
1971	41,140	28,110	13,030	50,780	18,643	32,137	(5,613)	-43%	(9,640)	-19%	41,500	47,500	(6,000)	-13%	68%
1972	52,790	30,470	22,320	30,995	13,616	17,379	8,704	39%	21,795	70%	46,700	32,000	14,700	46%	65%
1973	38,650	18,820	19,830	21,650	10,636	11,014	9,194	46%	17,000	79%	30,000	22,300	7,700	35%	63%
1974	27,830	7,500	20,330	29,150	19,334	9,816	996	5%	(1,320)	-5%	15,600	21,900	(6,300)	-29%	48%
1975	28,740	8,435	20,305	45,937	28,496	17,441	(8,191)	-40%	(17,197)	-37%	19,900	26,200	(6,300)	-24%	42%
1976	45,202	25,702	19,500	48,940	18,860	30,080	640	3%	(3,738)	-8%	37,100	44,400	(7,300)	-16%	69%
1977	43,650	23,740	19,910	56,495	21,695	34,800	(1,785)	-9%	(12,845)	-23%	34,700	50,800	(16,100)	-32%	68%
1978	70,323	48,737	21,586	97,940	36,020	61,920	(14,434)	-67%	(27,617)	-28%	62,900	82,300	(19,400)	-24%	77%
1979	84,960	57,210	27,750	108,323	37,985	70,338	(10,235)	-37%	(23,363)	-22%	72,000	88,800	(16,800)	-19%	79%
1980	124,930	86,360	38,570	144,096	62,490	81,606	(23,920)	-62%	(19,166)	-13%	102,600	110,000	(7,400)	-7%	84%
1981	78,500	55,420	23,080	116,095	28,895	87,200	(5,815)	-25%	(37,595)	-32%	74,500	113,300	(38,800)	-34%	74%
1982	136,060	109,940	26,120	105,503	27,983	77,520	(1,863)	-7%	30,557	29%	135,000	109,100	25,900	24%	81%
1983	97,210	74,330	22,880	129,363	28,672	100,691	(5,792)	-25%	(32,153)	-25%	94,000	127,200	(33,200)	-26%	79%
1984	119,068	81,671	37,397	150,034	47,410	102,624	(10,013)	-27%	(30,966)	-21%	103,560	132,505	(28,945)	-22%	79%
1985	123,629	86,891	36,738	164,115	43,916	120,199	(7,178)	-20%	(40,486)	-25%	108,241	144,610	(36,369)	-25%	80%
1986	147,935	113,532	34,403	137,827	37,257	100,570	(2,854)	-8%	10,108	7%	138,015	127,864	10,151	8%	82%
1987	95,275	66,736	30,839	105,932	30,697	75,235	142	0%	(10,657)	-10%	94,132	95,525	(1,393)	-1%	71%
1988	135,602	101,613	34,264	87,172	24,924	62,248	9,340	27%	48,430	56%	134,996	98,575	36,421	37%	75%
1989	133,900	102,400	31,500	184,000	54,400	129,600	(22,900)	-73%	(50,100)	-27%	127,000	156,000	(29,000)	-19%	81%
1970-89 Average	86,987	60,235	26,881	93,950	30,460	63,490	(3,579)	-13%	(6,963)	1%	75,839	81,230	(5,391)	-4.37%	72%
Averages without regard to sign							8,480	31%	24,721	31%			18,759	24%	

a/ Management Error is Escapement minus Escapement Goal

b/ Forecast Error is Return minus Actual Return

c/ This error is Projected Harvest minus Actual Harvest

d/ Forecast Harvest as a percent of Harvest Projection

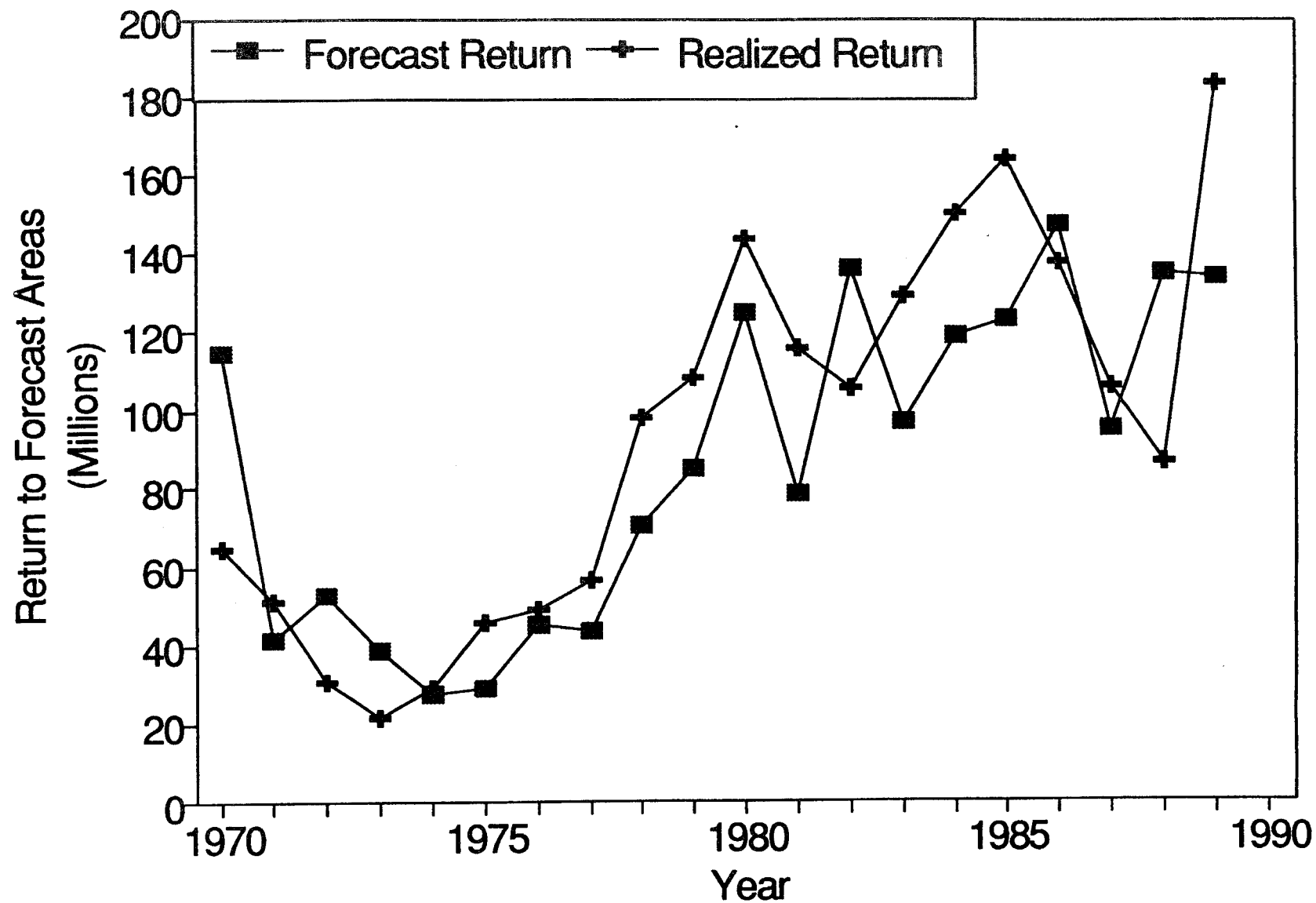


Figure 2. Relationship between observed return and forecast return for major salmon fisheries with formal forecasts.

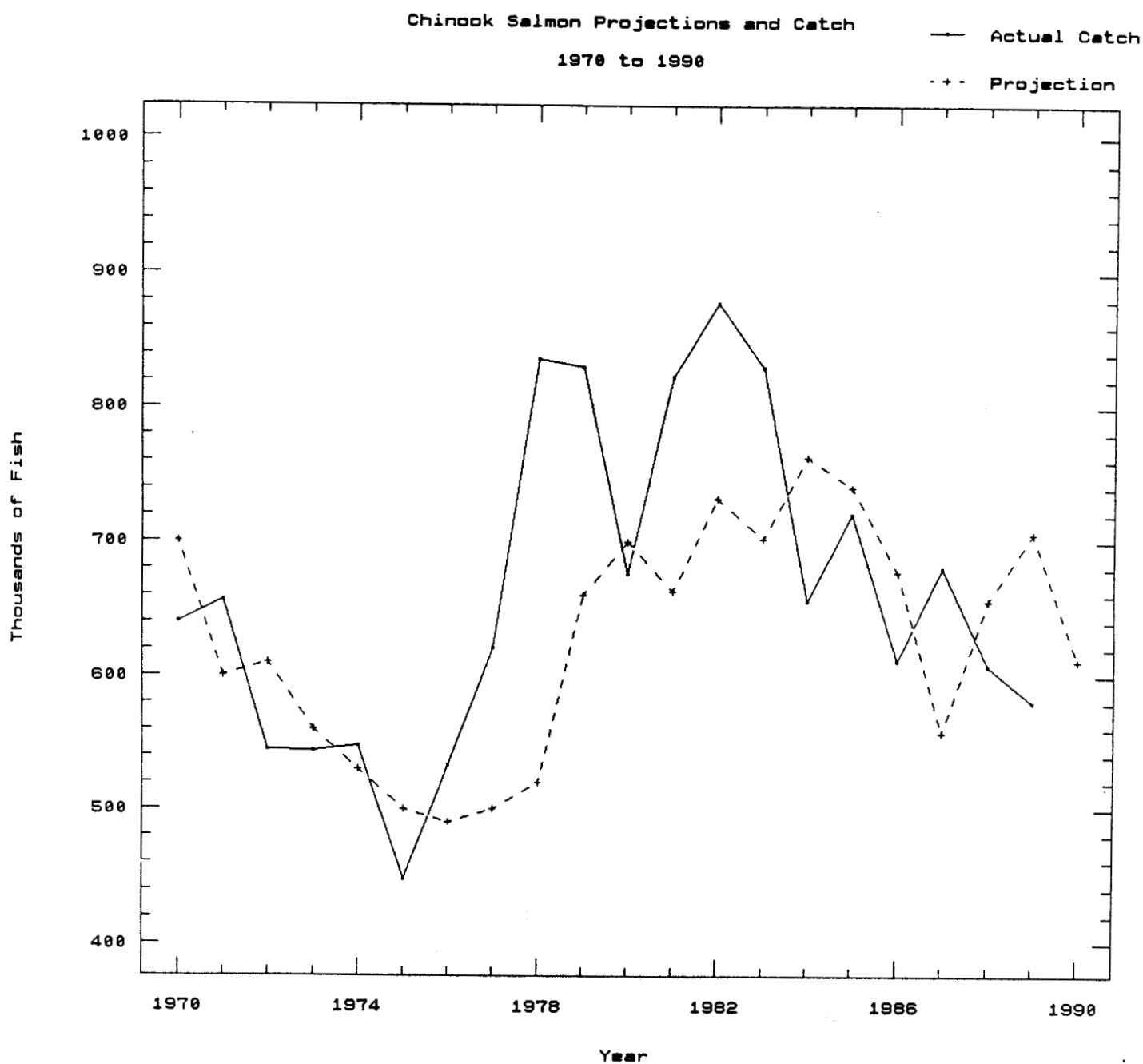


Figure 3. Relationship between actual catch (thousands) and projected catch (thousands) for Alaskan chinook salmon from 1970-1989, with the 1990 projection.

Sockeye Salmon Projections and Catch  
1970 to 1990

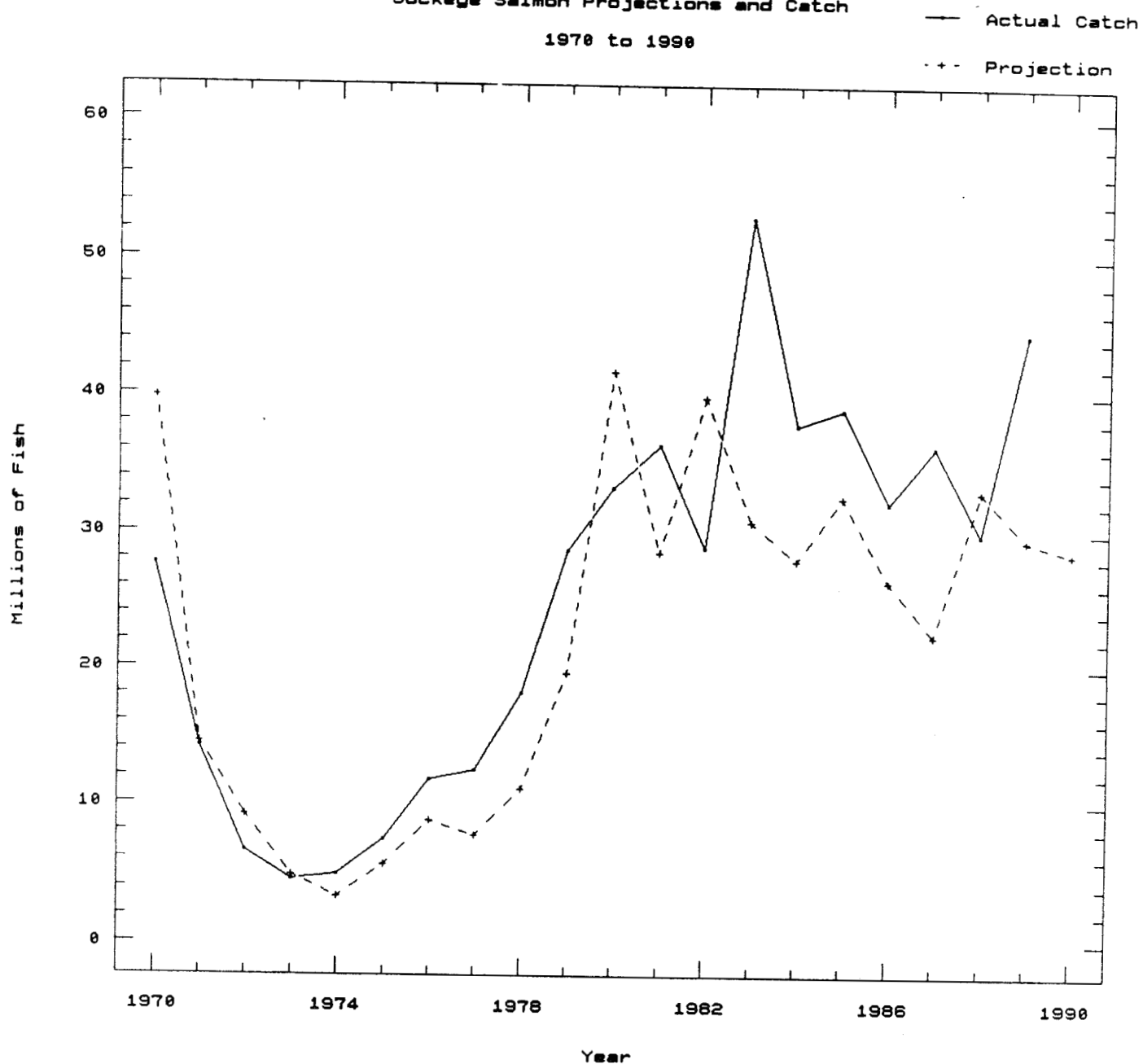


Figure 4. Relationship between actual catch (millions) and projected catch (millions) for Alaskan sockeye salmon from 1970-1989, with the 1990 projection.

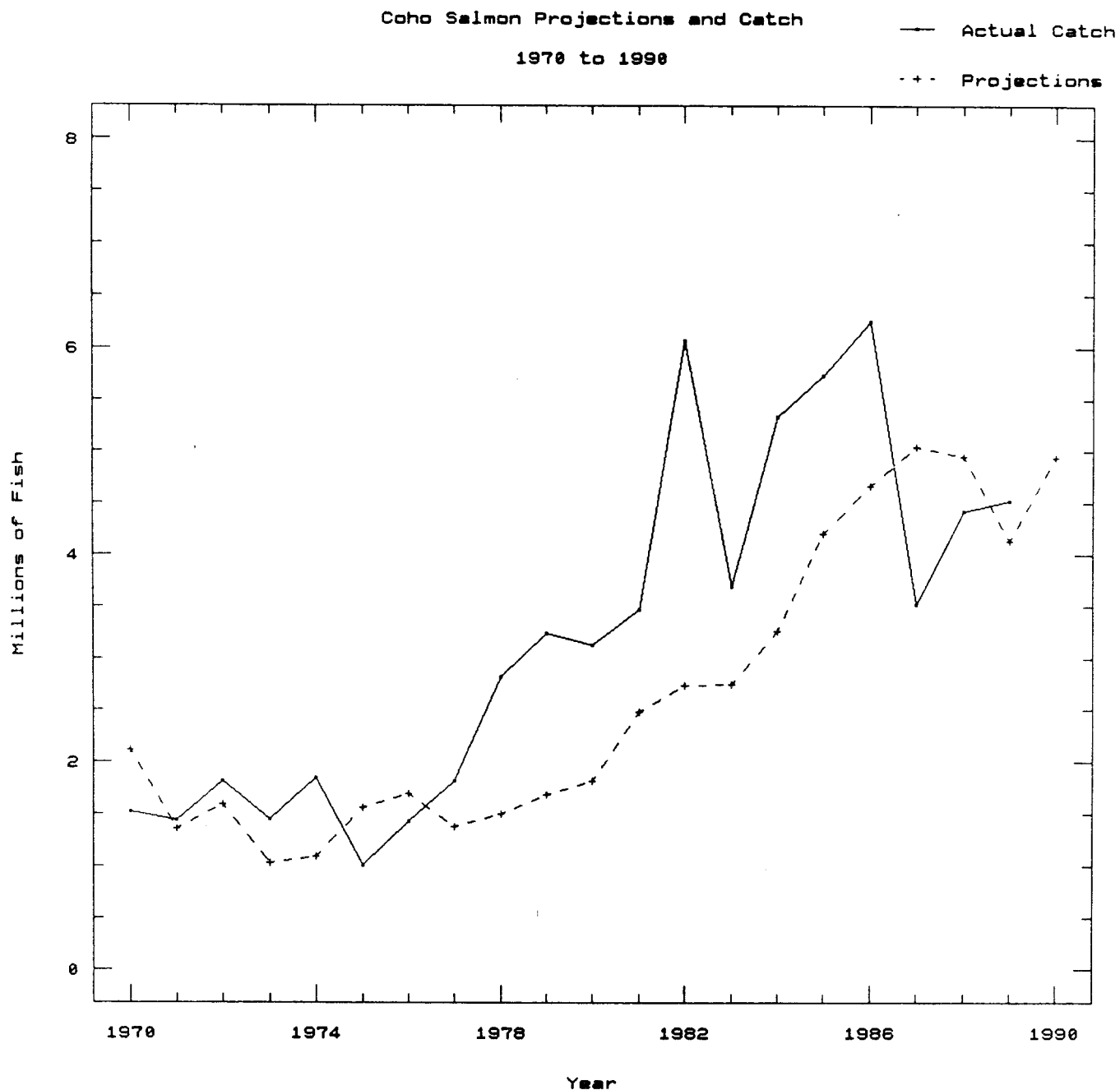


Figure 5. Relationship between actual catch (millions) and projected catch (millions) for Alaskan coho salmon from 1970-1989, with the 1990 projection.

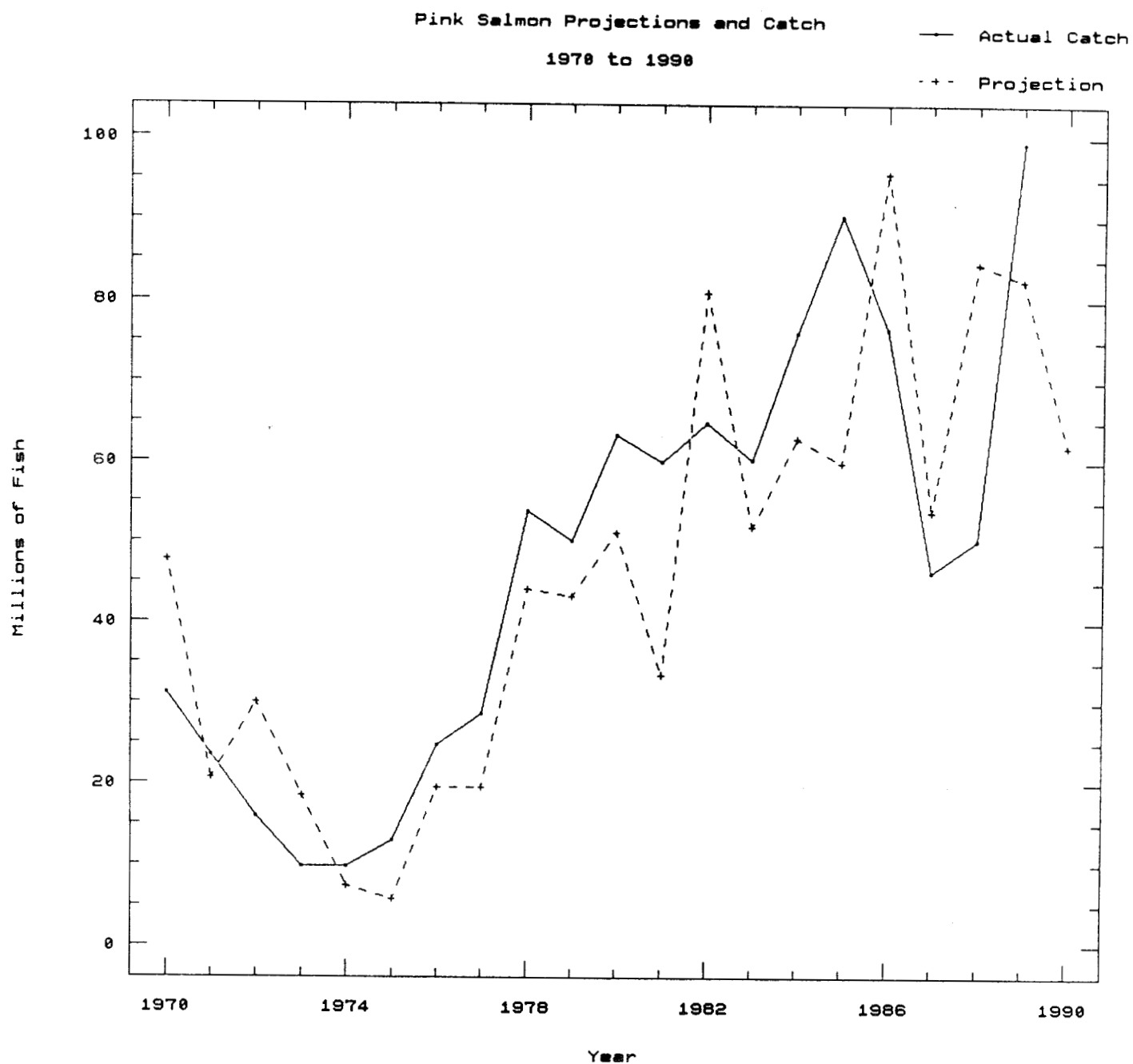


Figure 6. Relationship between actual catch (millions) and projected catch (millions) for Alaskan pink salmon from 1970-1989, with the 1990 projection.



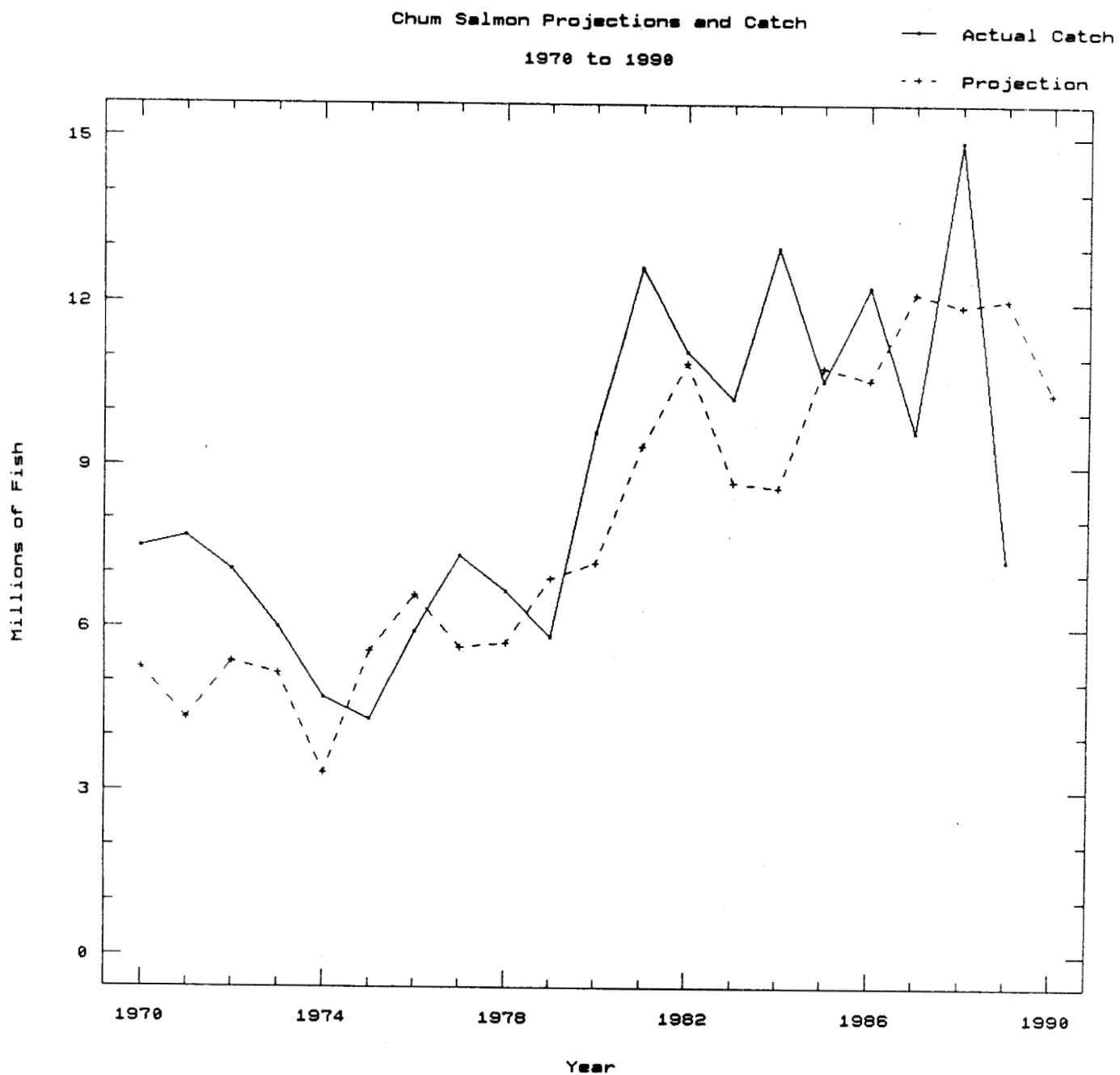


Figure 7. Relationship between actual catch (millions) and projected catch (millions) for Alaskan chum salmon from 1970-1989, with the 1990 projection.

Common and Vernacular NamesScientific Name

chinook, (king)	<i>Oncorhynchus tshawytscha</i>
sockeye, (red)	<i>Oncorhynchus nerka</i>
coho, (silver)	<i>Oncorhynchus kisutch</i>
pink, (humpy, humpback)	<i>Oncorhynchus gorbusha</i>
chum, (dog)	<i>Oncorhynchus keta</i>

In the early 1970s salmon runs were weak throughout the state. Throughout the 1980's, conditions have worked in tandem with industry sacrifices and careful fisheries management to ensure adequate well-distributed salmon escapements. Salmon runs have been large in almost all areas of the state for nearly a decade, and we expect to continue to enjoy large salmon harvests. The 1989 fishery was severely disrupted in some areas of Alaska by the grounding of the *Exxon Valdez* oil tanker. The 1990 fishery will no doubt be disrupted by unknown biological and unanticipated management problems stemming from the *Exxon Valdez* oil spill not considered in these forecasts.

**DEFINITION OF TERMS**

Commercial Harvest:	Those fish harvested in fisheries other than sport and personal use, and intended to be used for sales. This category includes fish caught by the commercial fleet in the common property fishery, and fish harvested by hatchery operators for cost recovery.
Common Property Harvest:	Fish harvested by fishers holding limited entry permits, issued by the state of Alaska to harvest fish for commercial purposes.
Cost Recovery Harvest:	Fish harvested by hatchery operators, separately from the common property fishery, to fund the operation of the hatchery.
Escapement, spawning population or brood stock:	The portion of a salmon run which is not harvested and survives to reach the spawning grounds or hatchery.
Harvest projections or outlook:	Harvest outlooks are generated by local fisheries managers for all areas of the state. Harvests are based on the formal run forecasts where available. For fisheries where no formal run forecast was generated the harvest outlook is based on historical averages subjectively adjusted based on recent trends, and local knowledge of the fisheries situation. In general harvest outlooks are less reliable than formal run forecasts.

Run Forecast:

Forecasts of the run (harvests + escapement) are estimated using information such as parent-year escapements, subsequent fry abundance, spring sea water temperatures, and escapement requirements.

Salmon Run:

The total number of mature salmon returning in a given year from ocean rearing areas to coastal waters.

## PRELIMINARY REVIEW OF THE 1989 ALASKA COMMERCIAL SALMON FISHERY

The 1989 commercial salmon catch is estimated to have produced a harvest of over 153.3 million fish weighing a total of nearly 700 million pounds. This harvest exceeds the previous record of 146.3 million taken during the 1985 season.

The preliminary, advance-price, ex-vessel value is estimated at over \$505 million. As additional fish tickets are edited and entered into the system, and any year-end bonuses paid, this figure may rise. This is the second highest value for Alaska salmon fisheries in history, surpassed only by the 1988 figure estimated at over \$750 million. In 1989, salmon prices were calculated to be one-half to one-third lower than those paid in 1988. Factors contributing to these low ex-vessel prices include the reduced buying power of the Japanese yen (20% less than the previous year), surplus salmon inventories in Tokyo that were over 100,000 metric tons greater than existed the previous year, increased Japanese hatchery production of chum salmon, and increased sales of internationally farmed salmon on the open market.

The 1989 salmon harvest was considerably higher than the preseason run forecast of 127 million (Table 2). This was due in large part to the near record run of pink salmon to Southeast Alaska. Close to 59.4 million pink salmon were caught in Southeast Alaska waters in 1989, second only to the 1941 record of 60 million. Similarly, in 1989, Bristol Bay had the fourth largest run ever, resulting in the second largest harvest on record. For the third year in a row the Cook Inlet sockeye returns were also far above anticipated levels.

Hatchery contributions to Prince William Sound, Lower Cook Inlet, and Kodiak generously augmented harvests in those areas. Kodiak's Kitoi Bay hatchery actually accounted for over 80 percent of the area harvest, as nearly all common property fisheries remained closed for the season because of oil contamination from the tanker M/V *Exxon Valdez*, which spilled 10.8 million gallons after grounding on Bligh Reef, Prince William Sound. In the Sound, over 33 percent of the harvest resulted from hatchery cost recovery efforts. Harvests occurred in the terminal areas where no manageable common property fishery could be held because of the presence of oiled waters and beaches.

Lower Cook Inlet's (LCI) enhanced pink salmon runs again in 1989 played a major role in seine harvests for area fishermen, as they have in the past. The Fisheries Rehabilitation, Enhancement and Development (FRED) Division estimates that 67% (998,600 salmon) of the total 1989 LCI commercial salmon harvest of 1.5 million were enhancement fish. Leisure and Chenik Lake enhancement sockeye stocks produced approximately 73% (119,000) of the total LCI harvest of 163,000 sockeye this season. Additionally, the Tutka Lagoon Hatchery production along with FRED Division/Cook Inlet Seiners' Association cooperative rearing project at Halibut Cove Lagoon accounted for about 68% of the 1989 LCI commercial pink salmon harvest of 1.3 million fish. Estimates of the ex-vessel value of FRED Division produced salmon are at least 67% (\$1.7 million) of the total \$2.6 million LCI value for this year.

Preliminary 1989 catch estimates by fishing area and statistical region are summarized in Table 3. These estimates are presented in more detail by management region in Tables 4 through 7.

Table 2. Comparison of actual and forecast 1989 salmon runs, with errors and relative errors for some major Alaskan salmon fisheries. Units are millions of fish. a/

Area	Species	1989 Harvest	1989 Escapement	Run b/	Forecast Harvest	Forecast Run	Error c/	Relative Error d/
Southern Southeast	Pinks	45.1	8.6		13.8	19.8		
Northern Southeast	Pinks	12.6	4.6		7.0	11.6		
SE Troll	Pinks	1.7	----					
Southeast Total	Pinks	59.4	13.2	72.6	20.8	31.4	-41.2	-56.7%
Prince William Sound	Pinks	21.87	1.28	23.15	45.96	48.2	25.1	108.2%
	Chums	1.12	0.24	1.36	0.84	1.19	-0.17	-12.7%
PWS Coghill District	Sockeye	0.108	0.037	0.145	0.344	0.398	0.253	174.7%
Copper River	Sockeye	1.03	0.66	1.69	0.97	1.73	0.04	2.4%
	Chinook	0.031	0.037	0.068	0.042	0.057	-0.011	-15.6%
Upper Cook Inlet	Sockeye	4.90	2.01	6.91	2.5	4.00	-2.91	-42.1%
Kodiak	Pinks	6.62	20.00	26.62	10.6	12.75	-13.87	-52.1%
Upper Station, Early	Sockeye	0.059	0.065	0.124	0.072	0.134	0.010	8.4%
Upper Station, Late	Sockeye	0.485	0.222	0.707	0.779	0.929	0.222	31.5%
Frazer	Sockeye	0.362	0.360	0.722	0.367	0.537	-0.185	-25.6%
Chignik	Sockeye	1.16	0.94	2.10	1.45	2.10	-0.00	-0.2%
Bristol Bay Nushagak	Sockeye	29.3	15.3	44.6	17.6	30.3	-14.3	-32.1%
	Chinook	0.017	0.078	0.095	0.054	0.129	0.033	34.9%
Total		126.4	54.4	180.9	102.4	133.9		

a/ Table updated March 5, 1990.

b/ Run is Harvest plus Escapement

c/ Error is Forecast Run minus Run

d/ Relative Error is Error divided by Run times 100%

Table 3. Preliminary 1989 Alaska commercial salmon harvest by species and fishing area.

	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Fishing Area						
Southern Southeastern	21	1,123	430	45,095	1,188	47,856
Northern Southeastern	26	974	339	12,562	680	14,581
Southeast Troll	240	18	1,364	1,659	68	3,350
Southeastern Statistical Region Total	288	2,115	2,133	59,317	1,935	65,787
Cordova Area	32	1,175	425	21,886	1,002	24,521
Cook Inlet Area	27	5,070	279	1,359	135	6,870
Kodiak Area	0	1,290	3	6,621	20	7,933
Chignik	3	1,163	67	27	2	1,261
South Peninsula	7	2,661	444	7,293	994	11,398
Central Statistical Region Total	70	11,358	1,217	37,187	2,152	51,983
Aleutian Islands	0	8	0	7	0	15
North Peninsula	11	1,719	228	4	157	2,118
Bristol Bay Area	40	29,292	240	0	577	30,149
Kuskokwim Area	67	83	556	1	802	1,509
Yukon Area	102	0	83	0	1,230	1,415
Norton Sound	6	0	44	0	43	93
Kotzebue Area	0	0	0	0	255	255
Western Statistical Region Total	225	31,102	1,151	12	3,064	35,554
ALASKA TOTAL	583	44,575	4,500	96,516	7,152	153,325

1 Compiled 5 March 1990, catches in thousands of fish.

Table 4. Preliminary 1989 Southeastern Alaska commercial salmon harvests by species and management area.

Management Area	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	Total
<b>Southern Southeastern</b>						
Tree Point Drift Gill Net	1.80	144.93	31.93	1,347.84	298.15	1,824.65
Prince of Wales Gill Net	1.53	192.73	92.38	1,101.19	67.35	1,455.18
Gillnet Hatchery Terminal	1.87	0.28	3.17	2.09	11.37	18.78
Stikine River Gill Net	0.30	10.08	4.26	27.64	3.37	45.65
Southern Districts Seine	14.89	738.70	276.30	41,296.84	754.18	43,080.91
Annette Island Trap	0.32	2.73	0.47	496.26	0.48	500.26
Annette Island Gill Net	0.36	33.19	21.26	823.08	52.71	930.60
Blind Slough	0.07	0.00	0.00	0.00	0.00	0.07
<b>Southern Southeastern total</b>	<b>21.14</b>	<b>1,122.64</b>	<b>429.77</b>	<b>45,094.94</b>	<b>1,187.61</b>	<b>47,856.10</b>
<b>Northern Southeastern</b>						
Taku-Snettisham Gill Net	1.81	74.01	51.80	180.59	36.97	345.18
Lynn Canal Gill Net	1.99	471.93	50.30	110.43	123.67	758.32
Yakutat Gill Net	0.79	329.46	176.70	57.17	16.23	580.35
Northern Districts Seine	2.73	98.32	56.53	11,970.77	336.60	12,464.95
S.E. Hatchery Cost Recovery	18.80	0.71	3.43	243.49	166.13	432.56
<b>Northern Southeastern total</b>	<b>26.12</b>	<b>974.43</b>	<b>338.76</b>	<b>12,562.45</b>	<b>679.60</b>	<b>14,581.36</b>
<b>Southeast Troll 1/</b>	<b>240.22</b>	<b>17.93</b>	<b>1,364.04</b>	<b>1,659.38</b>	<b>68.23</b>	<b>3,349.80</b>
<b>SOUTHEASTERN REGION TOTAL</b>	<b>287.48</b>	<b>2,115.00</b>	<b>2,132.57</b>	<b>59,316.77</b>	<b>1,935.44</b>	<b>65,787.26</b>

1/ Includes catch from Winter Troll Fishery (October 1, 1988 - April 14, 1989).  
Compiled 04 January 1990, catches in thousands of fish.

Table 5. Preliminary 1989 Central Region Alaska commercial salmon harvests  
by species and management area.

	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	Total
-----						
Management Area						
-----						
Cordova Area						
Bering River	0.03	9.22	26.95	0.00	0.00	36.20
Copper River	30.86	1,025.92	194.44	25.87	5.84	1,282.93
Prince William Sound						
P.W.S. General	0.67	9.85	69.42	13,125.07	667.56	13,872.57
P.W.S. Hatcheries	0.00	0.02	52.30	8,006.37	129.52	8,188.21
Coghill District	0.36	106.11	80.73	628.52	194.58	1,010.30
Unakwik District	0.03	21.41	0.02	41.82	0.40	63.68
Misc.(Ed. permits, oil, etc.)	0.03	2.68	1.07	58.79	3.86	66.43
-----						
Prince William Sound Total	1.09	140.07	203.54	21,860.57	995.92	23,201.19
-----						
Cordova Area Total	31.98	1,175.21	424.93	21,886.44	1,001.76	24,520.32
-----						
Cook Inlet Area						
Lower Cook Inlet						
Southern District	1.88	98.05	6.66	987.48	3.14	1,097.21
Kamishak District	0.00	46.39	0.00	256.66	7.80	310.85
Outer District	0.00	10.28	0.07	52.67	0.04	63.06
Eastern District	0.00	8.53	0.00	0.09	0.31	8.93
-----						
Lower Cook Inlet Total	1.88	163.25	6.73	1,296.90	11.29	1,480.05
Upper Cook Inlet						
Central District	12.97	4,655.12	140.25	39.84	42.64	4,890.82
Northern District	12.34	251.23	131.78	22.54	80.81	498.70
-----						
Upper Cook Inlet Total	25.31	4,906.35	272.03	62.38	123.45	5,389.52
-----						
Cook Inlet Area Total	27.19	5,069.60	278.76	1,359.28	134.74	6,869.57
-----						
Bristol Bay						
Naknek-Kvichak District	6.61	13,909.03	22.66	0.09	101.05	14,039.44
Nushagak District	17.63	3,129.14	77.50	0.15	182.95	3,407.37
Egegik District	2.03	8,987.07	49.17	0.00	50.84	9,089.11
Ugashik District	2.11	3,177.73	33.94	0.02	38.89	3,252.69
Togiak District	11.36	88.87	56.43	0.17	203.12	359.95
-----						
Bristol Bay Total	39.74	29,291.84	239.70	0.43	576.85	30,148.56
=====						
CENTRAL REGION TOTAL	98.91	35,536.65	943.39	23,246.15	1,713.35	61,538.45

Compiled 05 March 1990, catches in thousands of fish.



Table 6. Preliminary 1989 Westward Region Alaska commercial salmon harvests by species and management area.

	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	Total
Management Area						
Kodiak Area	0.10	1,289.53	2.59	6,620.90	19.97	7,933.09
Chignik Area	3.27	1,162.70	66.60	27.30	1.62	1,261.49
Alaska Peninsula and Aleutians						
South Peninsula	7.05	2,660.71	443.84	7,292.66	994.23	11,398.49
North Peninsula	10.95	1,718.69	227.55	4.10	157.18	2,118.47
Aleutian Islands	0.00	8.25	0.00	6.70	0.00	14.95
Alaska Penin. Aleut. Total	17.99	4,387.64	671.39	7,303.46	1,151.41	13,531.90
WESTWARD REGION TOTAL	21.36	6,839.87	740.58	13,951.66	1,173.00	22,726.48

Compiled February 16, 1990, catches in thousands of fish.

Table 7. Preliminary 1989 Arctic-Yukon-Kuskokwim commercial salmon harvests by species and management area.

	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	Total
Management Area						
Kuskokwim Area						
Kuskokwim River	43.22	42.75	479.86	0.46	749.18	1,315.47
Kuskokwim Bay	23.79	39.88	76.46	0.31	53.02	193.46
Kuskokwim Area Total	67.01	82.63	556.32	0.77	802.20	1,508.93
Yukon River						
Lower Yukon River	94.02	0.00	67.17	0.00	1,090.28	1,251.47
1/ Upper Yukon River	7.83	0.00	16.17	0.00	139.92	163.92
Yukon River Total	101.85	0.00	83.34	0.00	1,230.20	1,415.39
Norton Sound	5.70	0.26	44.09	0.12	42.62	92.79
Kotzebue Area	0.08	0.00	0.00	0.00	254.61	254.69
ARCTIC-YUKON-KUSKOKWIM REGION	174.64	82.89	683.75	0.89	2,329.63	3,271.80
TOTAL						

1/ On the Upper Yukon River an additional 303,298 pounds of chum salmon roe was sold in addition to the fish sold in the round.

Compiled February 21, 1990, catches in thousands of fish.

### *Southeast Region*

The 1989 Southeast Alaska salmon catch for all species was approximately 65.8 million fish, valued at about \$128 million dollars to the fishermen. This catch ranks second only to the 1941 total harvest of 67.8 million.

The pink salmon harvest totaled approximately 59.4 million fish, which is over three times as much as the 1988 harvest. This figure is also over triple the 1989 Southeast Alaska forecasted level of 19.5 million pink salmon, and nearly surpassed the harvest record of 60 million pinks taken in 1941. Approximately 76 percent of the harvest was taken by southern Southeast Alaska purse seine fleet. Seiners in northern Southeast Alaska were provided additional fishing opportunities when the Board of Fisheries established the Hawk Inlet shoreline fishery. The Board directed that the Department close this fishery north of Point Marsden if more than 15,000 sockeye salmon were taken by the seine fleet during July. This fishery proved very successful, targeting on pink salmon while at the same time not exceeding the sockeye quota.

In 1989 the troll harvest was over 1.6 million pink salmon (2.8% of the total harvest); this was the highest number of pink salmon ever taken by troll gear, as many trollers targeted on them.

Due to the large volume of pink salmon harvested in Southeast Alaska this year, processors were forced to transport portions of the catch out of Southeast Alaska for processing. Canned production of pink salmon also returned to historically high levels.

The sockeye harvest of 2.1 million exceeded the preseason harvest projections of 1.5 million fish, with excellent catches again occurring in the Noyes Island fishery. Catches in Lynn Canal were the best ever reported.

The chum harvest fell far below the 3.5 million preseason projection, with a total harvest of only 1.9 million fish. Biologists speculate that the factors causing the exceptionally poor 1987/1988 pink salmon runs also negatively influenced the 1989 chum salmon runs.

Coho catch this season exceeded preseason run forecast harvest projections of 1.5 million fish, with harvests of about 2.1 million salmon. The troll catch alone is estimated to have landed approximately 1.4 million. Catch per unit of effort figures for troll gear were excellent for the entire region, particularly in the outside areas. The troll harvest through August 12 was 222 percent of the 1971-1980 average troll catch for that date. A ten day closure of the troll fishery was implemented on August 14 to comply with the Alaska Board of Fisheries Management Plan goal of allocation of coho salmon between the outside troll fishery and inside troll, net, and recreational fisheries, and to provide adequate migration of coho to inside areas to meet spawning requirements.

The troll fishery accounts for the largest portion of the Southeast Alaska chinook harvest of about 288,000 fish. In 1989 the troll harvest of 240,000 chinook represented about 84 percent of the total all gear chinook harvest. Approximately 34,100 chinook or about 15 percent of the total troll harvest were taken during the 1989 winter troll season from October 1, 1988 through April 14, 1989. The summer troll season consisted of several limited openings during

June to access Alaska hatchery chinook, plus a general summer opening July 1-13. Approximately 33,200 chinook were harvested during special June openings.

The 1989 general summer troll season remained open for 13 days. This was the second shortest season on record. Approximately 167,300 chinook were taken during this period for an average catch rate of 12,900 chinook per fleet day. This was similar to the 1988 general summer season which had a 12-day chinook opening with an average daily catch rate of 13,500. Chinook non-retention regulations were implemented during the remainder of the summer troll season from July 14 through August 13, and August 24 through September 20. Several outer coastal areas of frequent high chinook abundance were again closed to all trolling during chinook non-retention periods to reduce chinook hook and release.

### *Central Region*

#### Prince William Sound

The Prince William Sound Area (PWS) combined commercial salmon harvest for 1989 was 24.5 million fish. This catch is slightly above the ten year average of 20.0 million fish, however an exceptionally large portion of this catch (33%) was composed of hatchery sales from the private-non-profit hatcheries, leaving a common property portion of the catch below the 10 year average. It also fell far below preseason harvest projections of 48.17 million salmon.

A poor return of wild stock pink salmon was again observed in the Sound, which was particularly disappointing in light of the bright run forecast. Sockeye runs were above average in the Copper and Bering River Districts but especially weak in the Coghill District. Coho and chum production fell close to the average harvest level for the past ten years.

The March 24 grounding of the tanker M/V *Exxon Valdez* and resulting oil spill had a great impact on the management, as well as the quantity and quality of the 1989 salmon harvest.

Operating under the guidelines provided by the memorandum of understanding (MOU) signed on June 8, 1989 by the Alaska Departments of Fish and Game and Environmental Conservation, significant measures were taken to insure that the salmon harvest would not be compromised by contamination from the spill. Test fisheries, aerial surveys, beach walks and water quality sampling programs were employed to evaluate the likelihood of the fishery encountering oil that would contaminate fishing gear or adulterate the catch. Because of the extensive beach oiling, the Montague, Southwestern and Eshamy Districts as well as portions of the Northern and Northwestern Districts remained closed throughout the 1989 season.

In separate incidents on consecutive days in the Esther Subdistrict and in the Cannery Creek hatchery terminal area, oil was encountered by the commercial fishing fleet which required an immediate closure of the fishery. The fishery was reopened 10 days later, with a highly regulated on-the-grounds monitoring program and field announcement openings and closures similar to herring sac roe fisheries. The ten day closure, which occurred near the peak of hatchery returns

to Cannery Creek and Esther, resulted in a high percentage of lower grade fish in the commercial catch.

The value of the combined commercial salmon harvest is estimated at \$43 million, excluding hatchery sales. The drift gill net catch is valued at approximately \$23.8 million, setting the average earnings for the estimated 480 permit holders that fished in 1989 at \$49,470. Seiners harvested about \$18.9 million worth of fish setting the average earnings for the estimated 235 permit fleet at \$80,610. Because the Eshamy District was closed for the season, set net fishermen had no opportunity to fish in the Prince William Sound area in 1989. Escapements throughout the Sound were mixed but for the most part adequate. The wild stock pink systems of the Southwestern and Montague Districts and adjacent areas that remained closed though the season had unexploited runs which resulted in escapements exceeding minimum desired levels while the Eshamy Lake sockeye escapement was substantially above escapement goals. Minimum spawning objectives were reached or exceeded for the Copper River sockeye, chinook and coho salmon.

A total of approximately 32,000 chinook, 1.175 million sockeye, 425,000 coho, 21.9 million pink, and 1.0 million chum salmon were caught.

#### Upper Cook Inlet

The presence of crude oil, in the form of mousse patties, throughout the tidal rip areas of the Central District resulted in the complete closure of the drift gill net fishery. Initial closures were made week-by-week, extending into longer-term closures as the season progressed and oil distribution trends were more clearly defined. Mapping was accomplished through use of six test fishing vessels working under department direction and supervision. Oil did not prove to be a major problem in the set gill net fishery. Only one limited closure (the Upper Subdistrict south of the Kasilof River) was required on July 7.

The harvest of nearly 5.4 million salmon ranks as the eighth best season on record, although the large percentage of the more highly valued sockeye salmon produced the third largest ex-vessel value (approximately \$57.8 million).

*Sockeye Salmon.* The catch of 5.0 million sockeye salmon is the fourth highest on record and accounted for 95% of the ex-vessel value of the total fishery. The harvest was double the preseason run forecast of 2.5 million, largely because of a greater than anticipated run to the Kenai River. Other major systems produced only poor to fair runs. Accordingly, 95% of the sockeye salmon harvest was taken in the Upper Subdistrict (the eastside set net fishery) with at least a portion of this area open for 26 consecutive days. The fishery was surprisingly successful in dealing with the large Kenai River surplus although the escapement of 1.6 million sockeye salmon was more than double the maximum goal. Concern for escapement in the Kasilof River limited the openings for the lower eastside set nets during the peak of the run. The Kasilof escapement totaled 156,000, just slightly above the minimum goal. The Yentna River escapement fell just short of the 100,000 minimum goal while the Crescent River escapement of 70,000 was well within the desired range.

The newly created fishery in late May and June near Big River proved disappointing, producing a sockeye salmon catch of only 4,000 while the 950 chinook salmon catch was only slightly below the 1,000 fish cap established by

the Board of Fisheries. Although the sockeye salmon run to Fish Creek did not appear to be as strong as forecast, the lack of a drift fishery resulted in a substantial surplus escaping past traditional fisheries. The Knik Arm terminal fishery was open from July 23 through July 29 and produced a harvest of 42,000 sockeye salmon and 7,000 coho salmon. The Fish Creek escapement was 67,000.

*Chum Salmon.* The lack of a drift fishery, which normally accounts for 90% of the chum salmon catch, was the primary reason for the dismal catch of only 123,000 chum salmon, the lowest harvest on record. The Susitna River run appeared to be fair to poor although escapement, as indexed at the Yentna sonar site, was excellent. The Chinitna Bay run was very poor, forcing a closure of the set net fishery in early August and delaying the drift opening there until August 28. Surveys indicated that escapement was not satisfactory.

*Coho Salmon.* The current coho salmon harvest of 272,000 is the lowest in 9 years but equal to the long term average. Run strength to the principle systems appeared to be fair to good with late-run stocks appearing strong. Escapement of early-run Kenai River coho was poor during late July and early August because the early run was quite late but appeared average after the season progressed. Susitna River coho escapement, as indexed at Yentna, was excellent.

*Pink Salmon.* The 62,400 pink salmon harvest was well below expected levels, primarily because of the lack of a drift fishery. Run strength appeared normal for an odd year, and the Yentna River escapement was substantially above average.

*Chinook Salmon.* The chinook salmon catch of 25,300 was near expected levels. The targeted fishery in the Northern District produced a harvest of 10,333 chinook salmon, below the regulatory quota of 12,500. Most of the remaining harvest occurred in the Central District eastside set net fishery. Escapement of late-run Kenai River chinook salmon fell just slightly below the newly established optimum goal of 22,500.

#### Lower Cook Inlet

The 1989 harvest of 1,480,138 salmon ranks as the eighth best season over the last 30 years. The total ex-vessel value of the fishery was approximately \$2.56 million.

*Chinook Salmon.* The chinook salmon catch of 1,893 fish is a record and was due entirely to enhanced production in the Halibut Cove Lagoon and Seldovia Bay areas. Set gill nets accounted for 68% of the catch. Set gill nets in Seldovia Bay, which have averaged less than 10 chinook salmon per year since 1971, had a harvest of 182 chinook this year.

*Sockeye Salmon.* The runs to lake stocking projects at Chenik and Leisure Lakes were much weaker than projected, and continued poor production at English Bay Lakes and Delight and Desire Lakes in Nuka Bay resulted in a harvest considerably below the pre-season projected harvest of 425,000 fish. The harvest of 163,271 sockeye was 65 percent above average for Lower Cook Inlet, but 38,900 fish were harvested in the Cook Inlet Aquaculture Association terminal harvest area at Chenik Lake. Spawning escapements were good in all systems except English Bay Lakes. One exciting turn of events was the discovery of approximately 2,000 sockeye in a third lake system in Nuka Bay. This new lake system is comprised

of two small lakes created by a receding glacier located two miles north of Desire Lake in McCarty Fjord.

*Coho Salmon.* The coho harvest of 6,743 fish, although below average, was very good considering that the major harvest areas could not be opened because of the presence of oil. Set nets in the Southern District harvested 71% of the fish with the catch of 4,792 coho being the fifth highest on record. Incidental seine catches of coho during directed pink and chum salmon fisheries indicated runs were very good, but adverse weather in late August and September prevented aerial survey estimates of escapements in several key producing systems.

*Pink Salmon.* Pink salmon returns were generally much stronger than forecasted for all areas of Lower Cook Inlet. The harvest of 1,296,926 pink salmon was 55% above average. Returns to the Tutka Hatchery facility in Tutka Bay and Halibut Cove Lagoon accounted for 880,000 fish or 68% of the harvest. The Kamishak District catch of 256,669 was 25% above the pre-season projection and was the second largest catch on record. Harvests at Desire Creek and Humpy Creek accounted for the remainder of the harvest.

Escapements were generally achieved in most major producing systems. Because of oil problems several subdistricts in the Outer District could not be opened to seining. Severe "over escapement" occurred to the three major pink salmon streams in the Kamishak District, and was primarily the result of several problems relating to the oil spill.

*Chum Salmon.* The chum salmon harvest of 11,305 fish was the lowest on record and represented only 8.7% of the pre-season projected harvest. Runs were definitely weaker than anticipated. The complete closure of the southern portion of the Kamishak District because of oil was required. Spawning escapement were generally good in the Kamishak District, but were below desired levels in the other three districts.

*Subsistence-Personal Use.* The subsistence fishery in the Port Graham-English Bay area was open from April 1 to May 31 and was closed from June 1 to July 12 because of the poor sockeye run to English Bay Lakes. The fishery reopened from July 13 to September 30. No gill net harvest occurred because of concern over the potential for ingestion of oil contaminated fish by village residents.

Personal use permit issuance for Kachemak Bay continued an upward trend for the second consecutive year after remaining relatively stable from 1981 to 1987. A total of 466 permits, an 8% increase from 1988, were issued this year. Based on preliminary returns, the coho harvest of 7,215 fish was very good and was the second highest on record; the record coho harvest is 7,303 set in 1982. Coho runs to stocking projects in Caribou Lake and on Homer Spit contributed greatly to the increased harvest and possibly the increased fishing effort.

## Bristol Bay

The 1989 Bristol Bay commercial salmon season was a very productive one highlighted by a much greater than expected run of sockeye salmon. The inshore sockeye run totaled 44.0 million fish as compared to the preseason run forecast of 28.9 million. All districts except Togiak experienced greater than expected sockeye runs. A commercial harvest of 28.7 million sockeye was achieved, the

second largest on record for Bristol Bay, trailing only the 37.4 million fish harvested 1983. The 1989 total sockeye salmon run was the fourth largest recorded over the 38 years (1952-1989) that total run data have been collected. It was exceeded only by runs in 1980 (62.5 million), 1965 (53.1 million), and 1983 (45.9 million). It was approximately twice the 38 year average (21.8 million).

The commercial chinook salmon harvest totaled 40,000 fish, the second smallest harvest recorded over the 40 year period (1950 to 1989). Only the 30,000 fish catch in 1975 was smaller. It was far below the 20 year harvest average (1969 to 1988) of 121,000 fish. The chum salmon harvest totaled 1,172,000 fish, slightly above the 20 year average of 1,043,000. The pink salmon harvest totaled less than 1,000 fish, normal for an off cycle year. The coho salmon catch was 238,384 fish. This total is slightly below the 10 year (1979 to 1989) average harvest of 290,000 coho salmon. Prior to 1979 coho salmon were not emphasized nearly as intensively in the harvest.

The total bay-wide salmon harvest for 1989 stands at approximately 30,164,000 fish. The estimated total ex-vessel value of the 1989 salmon fisheries is \$174.5 million, the second highest on record exceeded only by the 1988 value of \$180.3 million.

*Sockeye Salmon.* The 1989 inshore sockeye salmon run of 44.0 million is 15.1 million fish greater than forecast. All districts except Togiak shared in the greater than anticipated run, and all but Togiak exceeded the escapement point goals. The dominant age group in the run was the 5(3) component (age 2.2). The peak run timing appeared normal in most districts, although as in most years of high return, the runs started strong early and had long tails. The issue of sockeye interception at Egegik remained a prime topic of discussion on the grounds during the season, but because of large runs in adjoining districts, it was not the focal point of fishermen/media attention as in 1988. Preliminary scale pattern studies of portions of the Egegik District sockeye catch indicated interception was again evident, particularly in the age group 5(3) fish destined for the Kvichak District. Analysis of other age groups is currently continuing. The poor performance of the Togiak sockeye run in light of strong runs to the rest of Bristol Bay remains an enigma. Both the major sockeye producing areas in the Togiak District (Togiak and Kulukak Rivers) yielded very weak runs.

*Chinook Salmon.* The chinook salmon run to all Bristol Bay districts was disappointingly small for the third consecutive year. Commercial harvests were below average in every district. This marks the fourth consecutive year that commercial chinook salmon harvests in Bristol Bay districts have been below average.

Escapements were also poor to fair bay-wide. An extensive commercial fishing closure (nearly a month) was necessary to obtain approximately 78,000 chinook salmon in the Nushagak River escapement (point escapement goal = 75,000). The Naknek and Egegik District escapements were also lower than desired. This decline seems to be affecting all Bristol Bay districts which would tend to indicate an ocean survival problem rather than an isolated fresh-water mortality factor from a particular drainage.

*Chum Salmon.* The chum salmon harvests in Bristol Bay were a little above average in the Naknek-Kvichak, Egegik, and Ugashik Districts while slightly below average in the Nushagak and Togiak Districts. Overall, the bay-wide harvest of 1,172,000



chums was slightly above the 1969 to 1988 average of 1,043,000. The extensive fishing necessary to harvest excess sockeye was responsible for weak chum escapements in the Naknek-Kvichak, Egegik, and Ugashik Districts.

*Pink Salmon.* Pink salmon return in strength during even numbered years on Bristol Bay. The cycle is very weak during odd numbered years and the 1989 season was no exception, yielding a commercial harvest of 511 fish.

*Coho Salmon.* The 1989 coho salmon harvest was about average in all Bristol Bay districts except the Nushagak. The Nushagak harvest of 77,000 coho was about half the 136,000 ten year average (1979 to 1989). Fishing time was reduced by Emergency Order at times in the Egegik, Nushagak, and Togiak Districts in attempts to boost escapement rates. The estimated harvest of coho is approximately 242,000 fish.

### *Arctic-Yukon-Kuskokwim*

#### Yukon River

A total of 1,441,240 salmon were commercially harvested in the Alaskan portion of the Yukon River in 1989. The catch was composed of 102,296 chinook salmon, 966,279 summer chum, 287,179 fall chum, and 85,486 coho salmon. Additionally, a record 288,549 pounds of summer chum salmon roe and 14,749 pounds of fall chum salmon roe were harvested. The chinook salmon catch was 15 percent below the recent 5-year average (1984-1988). The summer chum salmon and roe production were 41 percent and 35 percent, respectively, greater than the recent 5-year average. The fall chum salmon harvest in the Alaska portion of the drainage was 85 percent greater than the 1984-1988 average. A near record coho harvest was achieved. The commercial harvest by Canadian fishermen was 9,439 chinook salmon (18 percent below the 5-year average), and approximately 17,000 fall chum salmon (40 percent below the recent 5-year average). Yukon River fishermen in Alaska received an estimated \$10.1 million for their catch, approximately 30 percent greater than the recent 5-year average. Nine buyer-processors operated in the Lower Yukon Area, and 16 buyer-processors and 11 registered catcher-sellers operated in the Upper Yukon Area of Alaska. The Lower Yukon Area includes the coastal waters of the delta and that portion of the drainage from the mouth to Old Paradise Village (River Mile 301). The Upper Yukon Area is that portion of the drainage upstream of Old Paradise Village to the US/Canada border, including the Tanana River drainage.

Lower Yukon fishermen received an average price per pound of \$2.77 for chinook, \$0.34 for summer chum, \$0.50 for fall chum, and \$0.66 for coho salmon. Upper Yukon commercial fishermen received an estimated per-pound average price of \$0.83 for chinook, \$0.27 for summer chum, \$0.27 for fall chum, \$0.35 for coho salmon, and \$4.41 for salmon roe.

The Yukon delta was generally free of ice by May 31. Chinook salmon migratory timing into the lower river appeared to be about average while summer chum salmon migratory timing was early. In response to early run timing and the large abundance of summer chum salmon, special restricted mesh size (six inch or smaller) fishing periods were implemented prior to the first unrestricted mesh size fishing periods in Districts 1 and 2. This allowed an earlier start of the

commercial fishing season and an increased harvest of summer chum salmon than would have resulted if the fishery had been delayed until sufficient chinook were present to initiate the unrestricted mesh size fishery.

Commercial chum salmon harvests in 1988 and early in the 1989 season indicated that 12-hour fishing periods provided ample opportunity for fishermen to harvest chums and to allow buyers to handle the volume of fish during a large run. This schedule was maintained for the summer chum fishery, resulting in a 12-hour reduction in fishing time per period from prior years during this portion of the run. The commercial fishing season closed July 15 by regulation.

As in recent years, the summer chum salmon fishery in District 4 was predominantly a salmon roe fishery. There were twelve 48-hour periods this season, resulting in the sale of 283,300 pounds of chum roe and 18,600 fish in the round.

Initially, fall chum salmon migratory timing into the lower river appeared to be early. However, by late August, it was apparent that run timing was average and of longer duration than other comparable years. The fall season commercial salmon fishery was opened by emergency order on July 28 in District 1, and July 30 in Districts 2 and 3. A total of 143,000 fall chums had been taken as of August 16. Historical test fishing and sonar data indicated that usually by August 17 over 80 percent of the run has passed. However, additional fishing pressure was allowed after that date as chum catches increased in the test fishery. The commercial fishing season closed by emergency order on August 25 in District 1 and on August 27 in Districts 2 and 3. Sonar data indicated that coho salmon passage rates were lower than all previous years (1985-1988).

The summer chum and chinook salmon fishery in District 4 was closed on August 1 in order to evaluate the early portion of the fall run prior to allowing any commercial removal. Based on catches from the test fish wheel near Ruby and on subsistence catches, the run was judged to be as strong or stronger than anticipated. Accordingly, the commercial fishing season was reopened on August 6.

Although fall chum salmon escapements appeared to be good in the Tanana and Porcupine River drainages, escapement in the mainstem Yukon River in Canada was well below desired levels. The Department of Fisheries and Oceans preliminary spawning escapement estimate based on mark and recapture was approximately 35,000 fish, well below the interim escapement objective of 90,000-135,000 fish.

#### Kuskokwim

The first three periods in the lower Kuskokwim River District had a below normal fishing effort due to a strike for higher prices by the fishermen. Labor negotiators settled the strike, and the fishing season continued in a normal manner for the duration of the season. The estimated value of the Kuskokwim salmon fishery for 1989 is approximately 5.2 million dollars. This is less than half of the 1988 value estimate (\$12.36 million). The chinook catch of 43,200 in the Kuskokwim River Districts 1 and 2 exceeded the five-year average of 36,200. The sockeye catch of 42,700 was the second lowest on record for the last decade. The chum salmon catch of 749,200 exceeded the previous five-year average of 577,700 as well as being the second highest catch on record. The chum salmon catch in 1988 was twice the previous record at 1,381,700. The 1989 coho salmon

catch of 474,900 is the 4th highest catch and below the five-year average of 508,500. The commercial coho catches in 1984 and 1986 were records at 623,500 and 660,000 and dominated the average.

The chinook harvest of 20,800 in District 4, Quinhagak, was 4,500 lower than the previous five-year average. The sockeye harvest of 20,600 was comparable to 1986 and 1988 catches of 21,000. The sockeye harvest was well above the previous five year average of 14,900. The coho catch was average to below average at 44,600, compared to the five-year average of 68,300 coho salmon. The chum catch of 39,400 is above the five-year average of 27,600.

District 5, Goodnews Bay, had a low chinook catch of 2,900. This was 2,000 lower than the previous five-year average. The sockeye catch of 19,000 is a low to average catch while the coho catch was average at 32,000. The 13,600 chum salmon harvested in this district was below the five-year average of 16,600 fish.

#### Norton Sound

The 1989 Norton Sound commercial salmon fishery produced a total catch of 92,811 fish. Chum salmon were again one of the primary commercial species in the Sound, with a catch of over 42,600 fish. However, this catch figure is down 61 percent from the 1988 chum harvest of 108,000 fish and is the lowest number of chum salmon commercially taken since 1967. The harvest was 73 percent below the 1979-1988 harvest. The low chum harvests were due primarily to the lack of a chum salmon market in subdistricts 1, 2, 3, and 4. Historically, subdistrict 2, the Golovin subdistrict, produces approximately one-half of the annual commercial chum harvest. At only \$0.18 per pound, these fishermen were offered some of the lowest prices in the State for their catch. Fishermen also tend to start later and quit earlier in the season as their profit margins dictate. The 1989 chum catch was valued at about \$133,250, which is 54 percent less than the 1988 value (\$290,000).

The coho salmon harvest was the fourth highest on record; however, it was 5 percent below both the 1984-1988 and 1979-1988 averages. This phenomenon is the result of increasing coho runs to the district in recent years, especially during the 1982-1984 seasons. A total of 44,100 coho were harvested with an estimated value of \$144,760.

The harvest of 5,707 chinook salmon in the Sound was 44 and 38 percent below the 1984-1988 and 1979-1988 averages, respectively. This harvest produced an estimated ex-vessel value of approximately \$76,500.

A total of 194 Commercial Fisheries Entry Commission (CFEC) permits were renewed, with 110 actually fished during the 1989 season. The number of participating fishermen this season was the lowest effort on record since total effort has been documented (1977 to present). The average effort for the past ten years (1979-1988) has been 161 fishermen. The low effort during the 1989 season can be attributed primarily to the lack of salmon markets during most of the season in the northern subdistricts of Norton Sound.

The total commercial ex-vessel value for the salmon fishery in Norton Sound is estimated at about \$355,900. These earnings rank as the lowest value on record since 1976 and were 46 percent below the 1984-88 average of \$668,400. Again,

the low value is attributed to the lack of competitive markets and the low prices paid per pound for all salmon species.

#### Kotzebue

The 1989 chum salmon catch of 254,600 fell short of the ten-year average of 333,900 fish by 24 percent. This catch is also far below last year's chum harvest of 353,000. The total chum harvest had an ex-vessel value of nearly \$614,000. This is down from last year's value of \$2.61 million. Again, price proved a major factor. Additionally, many fishermen found alternative job opportunities this summer thereby reducing effort.

### *Westward Region*

#### Kodiak

The 1989 Kodiak Area commercial salmon fishery was severely impacted by the March 24 M/V *Exxon Valdez* oil spill in Prince William Sound. Oil contaminated waters were widespread throughout the Kodiak Area to the point that commercial fishing activity occurred in only three geographically isolated locations, two of which provided for modified commercial fishing on natural stocks and one of which provided for a modified cost-recovery fishery on hatchery stocks.

Gear participation in these three "fisheries" was abnormal. One of the fisheries occurred in the exclusive set gillnet area of the Alitak District and only 46 percent of Kodiak's fishable gillnet permits participated in this fishery. The other fishery occurred extremely late in the season in a portion of the Inner Karluk Section, an exclusive seine area, and was very restricted on time and area available for fishing. Consequently only 1 percent of the fishable seine permits participated in this fishery. The third fishery occurred in a small terminal portion of the Kitoi Bay Section near the Kitoi Bay Hatchery. It occurred as a supplemental cost-recovery fishery and participating vessels were chosen from a predetermined list; this fishery was administered by the Kodiak Regional Aquaculture Association.

The 1989 total harvest was 7.86 million fish. The catch was comprised of about 100 chinook, 1.29 million sockeye, 2,600 coho, 6.55 million pink, and 20 thousand chum salmon. Because of oil impacts in the Kodiak area, the vast majority of the pink salmon harvest (6.4 million) came from cost recovery harvests at Kitoi Bay Hatchery on Afognak Island. The total Kodiak salmon catch this year is down 60 percent (11.3 million salmon) from last year and 42 percent (5.6 million fish) from the five-year average. It was also about half of the Department's preseason, projected harvest of 14.2 million salmon.

The ex-vessel value of the actual 1989 catch is estimated to be \$18.4 million. However, a fixed ex-vessel value of Kodiak's 1989 commercial salmon fishery cannot be provided until final settlement between permit holders and Exxon.

The 1989 actual escapement was obviously tremendous, especially for pink salmon (nearly 20 million actual as compared to about 4 million projected). The eventual

per-spawner, especially for pink salmon are expected to be at or near record low levels.

In summary, based on escapement estimates, the 1989 commercial salmon fishery under normal conditions probably would have yielded a record harvest from both natural and hatchery production, all species combined. Pre-season harvest projections would have been reasonably accurate except for pink salmon whose overall abundance in 1989 was over twice that of preseason estimates.

## Chignik

The 1989 Chignik salmon fishery opened on June 12. Test fishing on June 11 indicated a moderate buildup of salmon in Chignik Lagoon, and the escapement of 56,000 sockeye past the weir was within the desired range for this date. The Chignik Bay, Central, and Eastern Districts were opened for 24 hours. However, the presence of oil contaminated waters or beaches near Kilokak Rocks and the lack of associated monitoring in the Chignik Management Area resulted in closure of Eastern District waters north of 56 degrees 59 minutes North latitude. The harvest for this first period was approximately 59,000 sockeye salmon.

Escapement counts lagged after the first fishing period just meeting interim goals while test fishing on June 15 and 20 indicated that there was not enough buildup in the lagoon to justify a commercial fishery. This is the second year in a row that the Black Lake run has failed to develop as expected. The second fishing period occurred on June 26. Thirteen hours into this period the fishery was closed because of the close proximity of oil contaminated waters. The harvest for the 13 hour opening was estimated at 36,000 sockeye salmon.

The presence of oil contaminated waters or beaches dictated that normal management strategies be altered. For the remainder of the 1989 season the commercial fishery was restricted to Chignik Lagoon and Anchorage Bay. Fishing was restricted to daylight hours only. This altered traditional fishing patterns and placed a great deal of stress on fishermen by forcing the entire fleet to fish in a relatively small area.

Usually during the last week of June and first week of July, the Black Lake run is declining and the Chignik Lake run is beginning to develop. This time period is referred to as the transition period. The Black Lake minimum escapement goal of 350,000 sockeye salmon was achieved on June 30 and at that time the Chignik Lake run appeared to be developing as expected. Therefore, a commercial fishing period was announced for June 30 and July 1. The harvest for this two day period was approximately 54,000 sockeye.

The 1989 Chignik Lake run was larger than predicted. Run timing was later than normal with strong catches well into September. The daily catch rate during the last of July and during August was very stable and may be attributed to the fact that there were no cape fisheries outside of the Chignik Area. The altered management strategy of fishing in daylight hours resulted in more escapement than might have occurred under normal conditions. Preliminary in-season escapement estimates for the Chignik Lake stocks through August 9, the last day of counting at the weir, was 362,000 fish. This was well above the desired escapement of 250,000 fish.

The 1989 chinook salmon harvest was 3,530 fish. The catch was slightly over the 3,000 fish harvest prediction and represents 97.4 percent of the 1979-88 average catch of 3,600 chinook. The escapement totaled 3,316 fish.

The 1989 pink and chum salmon commercial fisheries were also restricted to Chignik Lagoon and Anchorage Bay. The harvest totaled only 27,300 pink and 1,600 chum salmon. Essentially, local pink and chum stocks were not utilized in 1989 because of oil contaminated waters in the outside areas of the Chignik Management Area. The 1989 harvest of pink and chum salmon represents only 2.7 percent and 0.7 percent of the 1979-88 average, respectively.

The 1989 Chignik Area coho salmon harvest totaled 66,600 fish. This was 34,000 fish less than the harvest projection and 41.5 percent of the 1979-88 average. Coho salmon systems in Chignik fishing districts, other than Chignik Bay, were not utilized in 1989 because of oil contaminated waters.

The ex-vessel value of salmon harvested within the Chignik Management Area is estimated at \$13,711,100. This figure is down substantially from the 1988 record setting value of over \$30 million.

#### Alaska Peninsula and Aleutians

*June South Unimak and Shumagin Islands Fisheries.* The allocations of sockeye salmon for the Shumagin Island Section and South Unimak District fisheries were 264,000 and 1,199,000 respectively. A chum salmon catch ceiling of 500,000 was placed on both fisheries combined.

Sockeye catch rates were much higher than anticipated. The allocations were exceeded in both fisheries but, the record catch of 190,600 fish on June 20 pushed the Shumagin catch greatly over the quota. The combined chum catch was 455,000. Catch rates for chum salmon were high early in the season but was very light on and after June 16 in the Shumagin Section and on the June 23 opening of the South Unimak District.

The total catch by species is as follows:

	<u>Kings</u>	<u>Sockeye</u>	<u>Coho</u>	<u>Pinks</u>	<u>Chums</u>
Shumagin Islands	500	397,000	0	45,000	47,000
South Unimak	<u>2,300</u>	<u>1,348,000</u>	<u>0</u>	<u>154,000</u>	<u>408,000</u>
Total	2,800	1,745,000	0	199,000	455,000

Fishing was allowed on only 4 days, totaling 72 hours in the Shumagin Island Section. Fishing was allowed during 5 days totaling 84 hours at South Unimak. High winds reduced much of the effort in both fisheries during June 19.

A total of 144 drift gillnet vessels participated in the 1989 South Unimak fishery. Set gillnetters totaled 65 with 14 and 51 fishing South Unimak and the Shumagin Section, respectively, prior to June 23. During June 23, when fishing was closed in the Shumagin Section, some of the area setnetters participated in the South Unimak fishery. The purse seiners participating in the combined South

Unimak-Shumagin June fisheries totaled 96 (some vessels fish part of the season in each area).

*Southeastern District Mainland.* The only fishing directed at Chignik bound sockeye salmon was a 16 hour fishing period on June 16 resulting in an estimated interception of 2,600 sockeye salmon (preliminary figures). It then became apparent that the Chignik sockeye run was much weaker than predicted, and no more fishing time was allowed under the Southeastern District Salmon Management Plan until July 26.

*South Peninsula Post June Fisheries.* The preliminary July-August catch was 4,200 chinook, 849,000 sockeye, 413,000 coho, 6,806,000 pink, and 519,000 chum salmon. The pink catch was much stronger than anticipated and was one of the three highest catches during the past 75 years. However, the chum catch was the weakest since 1979.

The July-August coho catch was the second (to 1988) highest on record. Major coho catch areas were the Shumagin (233,000), Balboa-Stepovak (71,000) Sections, and the South Unimak District (101,000). Pink catches in the above locations were Shumagin Section (2,285,000), South Unimak (106,000), and Balboa-Stepovak (2,641,000). South Unimak is basically a gillnet fishery, an even-year pink producer, and has been receiving increased effort during recent years. The Shumagin coho catch would likely have gone another 60,000 had seining not been closed because of the presence of immature salmon during July 13-24. Approximately 266,000 coho salmon (64%) of the South Peninsula July-August coho catch was taken during July 25 through August 5.

Large numbers of immature sockeye salmon were reported in the Shumagin Section during late June. However, fishery monitoring by a Department of Public Safety vessel indicated that the number of immature salmon was low (15-20 per set) during the July 6-7 period. During July 12, however, large numbers (200 per set) of immature sockeye salmon were observed by ADF&G, resulting in the closure of the Shumagin Islands seine fishery. Test fishing results showed a high number of immature salmon present through July 23. However, July 23 test fishing showed a substantial decrease in immatures. During earlier years when immature salmon were a problem they had disappeared by about July 23. It was decided to allow a closely monitored seine opening during July 25. During July 25 only about 15 immatures were observed per set, and it was decided to allow the fishery to continue. This was the first time since 1979 that immature salmon which were being gilled in seines, was a problem in the Shumagin Islands. Previous to 1979, immature salmon plagued the Shumagin purse seine fishery in 1963, 1968, 1969, and 1974.

Sockeye salmon were caught in high abundance throughout the Shumagin, Balboa-Stepovak, Outer Pavlof Bay Sections, and at the South Unimak District.

The preliminary fall (September) South Peninsula salmon catch was 30,000 sockeye, 13,000 coho, and 10,000 chum. Only part of the area was open in September because of poor chum escapements.

The indexed total pink salmon escapement of 1,871,000 was slightly over the average 1979-87 odd-year average of 1,789,000 and well above the 1987 parent escapement of 1,541,000. The indexed total chum salmon escapement totaled 310,000, the lowest since 1975 and well below the previous 10-year average of

485,000. Chum escapements were good in most early systems but were very poor in some of the late systems. The indexed total sockeye escapement of 78,000 was the highest since 1974 and well over the previous 10-year average of 52,000. Coho escapement information is very incomplete, however, based on information collected the total escapement was probably in the 25,000 to 75,000 range.

## Aleutian Islands

The Aleutian Island salmon catch totaled only 8,248 sockeye and 6,700 pinks. The Aleutian Island Area is an even-year pink salmon producer, however, Unalaska Bay occasionally produces substantial runs (the last being in 1981) during the odd year cycle. This year was disappointing. The 1989 escapement was lower than in 1987.

## North Peninsula

The preliminary 1989 North Peninsula Area harvest figures are 10,946 chinook, 1,718,689 sockeye, 227,551 coho, 4,103 pink, and 157,177 chum salmon.

Approximately 1.3 million sockeye were harvested between Port Moller and Strogonof Point. The Nelson Lagoon catch of 322,000 salmon was the third highest since 1960.

The peak (early July) portion of the Bear River run seemed to be missing while Nelson Lagoon was enjoying an excellent run. Generally, when Nelson Lagoon is strong, so is Bear River. Runs to Bear River were strong early and late but very weak during what should have been the peak period. The Ilnik and Port Heiden runs started out strong and then fell off abruptly. A long closure of the Bear River fishery greatly benefited the Sandy River run.

The North Peninsula chum runs were weak except for two Herendeen Bay streams. The catch of 157,000 chum salmon was the lowest since 1979 and far below the previous 10-year average of 466,000. The total escapement index of 212,000 was the lowest since 1975 and was less than half of the 1979-88 average of 493,000.

The coho catch of 227,000 was the second highest on record.

Coho escapement data is incomplete, but based on the available data, the escapement of coho salmon was probably between 150,000 to 250,000.

A total of 10,946 chinook salmon were harvested on the North Peninsula. This total is only about half of the previous 10-year average of 20,200. The total escapement index was 5,600, far below the 1979-88 average of 14,700.

The North Peninsula is not an important pink salmon producer. The 1989 catch was only 4,103 fish.



## PRELIMINARY FORECASTS OF 1990 SALMON RUNS TO SELECTED ALASKA FISHERIES

The Alaska Department of Fish and Game's management program includes a number of salmon run forecast projects. Forecast fisheries are selected using several criteria, including economic importance, feasibility, compatibility with existing programs, and management needs. For the 1990 fishing year, forecast fisheries are:

Southern Southeast	-	pink salmon
Northern Southeast	-	pink salmon
Prince William Sound	-	pink, chum, hatchery coho and Coghill District sockeye salmon
Prince William Sound/ Copper River	-	sockeye and chinook salmon
Upper Cook Inlet	-	sockeye salmon
Kodiak	-	pink and selected sockeye salmon stocks
Chignik	-	sockeye salmon
Bristol Bay	-	sockeye and chinook salmon

A variety of information was used to make salmon run forecasts, including escapement magnitudes and distribution, egg deposition, survival to intermediate life stages, high seas abundance, environmental conditions, and population age composition. A range of run possibilities are predicted for each forecast fishery. In general, based on past experience, the actual run can be expected to fall within the range (between the lower and upper limits) somewhat less than half the time.

Forecast abstracts are given below; the reader is referred to the Appendices for further details. Table 8 provides a run forecast, harvest projection, and ranges for all fisheries forecast in 1990.

### Southeast Alaska Pink Salmon

A harvest of 9.6 million pink salmon is expected in Southeast Alaska in 1990, with a total run of 20.4 million expected. This forecast has performed poorly for the last three years: over-forecast in 1987 and 1988, and under-forecast in 1989. In each of these last three years the run forecast was outside the forecast range. In Southern Southeast Alaska, escapement numbers and distribution were poor in the parent year of the fish returning in 1990, and there is additional concern because of possible mortality of pink salmon eggs because of flooding in some areas.

Table 8. Preliminary forecasts of salmon runs and commercial and hatchery cost recovery harvests of some Alaskan fisheries in 1990. 1/

Area	Species	Forecast Run	Escapement Goal	Forecast Harvest	Forecast Run Range	
Southern Southeast	Pinks	13.1	6	7.1	8.5	20.1
Northern Southeast	Pinks	6.8	4.8	2.0	3.5	13.2
S.E. Hatchery Production	Pink	0.5		0.5		
		20.4	10.8	9.6		
Prince William Sound	Pinks	28.61	2.41	26.20	20.73	40.40
	Chums	1.839	0.359	1.480	1.336	2.463
PWS Coghill District	Sockeye	0.0602	0.0545	0.0099	0.0247	0.1710
Copper River	Sockeye	1.373	0.715	0.658	1.205	1.541
	Chinook	0.0521	0.015	0.0371	0.0426	0.0616
Upper Cook Inlet	Sockeye	5.8	1.5	4.3	3.7	9.7
Lower Cook Inlet	Pinks	2.142	0.422	1.815	1.027	3.947
Kodiak	Pinks	15.96	4.17	11.79		
Upper Station, Early	Sockeye	0.070	0.050	0.020	0.012	0.137
Upper Station, Late	Sockeye	0.386	0.175	0.211	0.098	0.777
Frazer	Sockeye	0.564	0.170	0.394	0.288	0.862
Ayakulik	Sockeye	1.030	0.250	0.780	0.849	1.358
Chignik 2/	Sockeye	1.82	0.65	1.17	1.46	2.18
Bristol Bay 3/	Sockeye	26.7	10.7	16.0	20.1	34.0
Nushagak	Chinook	0.116	0.075	0.041	0.073	0.182
Total		106.9	32.5	74.5		

1/ Compiled February 22, 1990. Note catches in units of millions of fish.

2/ Includes intersepted Chignik bound salmon

3/ Bristol Bay harvest includes 1.3 million South Peninsula quota.

## Prince William Sound Pink, Chum, and Coghill River Sockeye Salmon

The extent to which the M/V *Exxon Valdez* oil spill will continue to disrupt fishing operations in Prince William Sound in 1990 is unknown. The total pink salmon harvest is expected to be 26.2 million with a total run expected to be 28.61 million. The escapement and hatchery broodstock need are expected to be 2.41 million, with 6.63 million of the total harvest going to hatchery cost recovery harvests. This leaves an expected common property harvest of 19.57 million pink salmon. The wild stock run is expected to be only 3.8 million pink salmon after the disastrous wild stock failure in 1988. The biological effects of the M/V *Exxon Valdez* oil spill on both hatchery and wild stocks may have been underestimated in this forecast. The chum salmon run is expected to be 1.84 million fish with a commercial harvest of 1.48 million. This includes 1.42 million for the common property harvest and .06 million for hatchery cost recovery. Wild chum salmon production is expected to be below average, but increased hatchery production is expected to cause the 1990 harvest to be above average. Coghill sockeye salmon production comes from Coghill Lake and the Main Bay Hatchery. Wild sockeye salmon production out of Coghill Lake is expected to be extremely poor, and all returning sockeye salmon will be managed to escape the commercial fishery. A commercial harvest of 9.9 thousand sockeye salmon is expected to come from fish returning to the Main Bay Hatchery.

## Copper River Sockeye and Chinook Salmon

1.373 million sockeye salmon are expected to return to the Copper River and result in a harvest of .658 million. The chinook salmon run to the Copper River is expected to be 52.1 thousand fish, with an expected harvest of 37.1 thousand.

## Upper Cook Inlet Sockeye Salmon

An expected 5.8 million fish are expected to return to the Upper Cook Inlet area, with an expected harvest of 4.3 million.

## Lower Cook Inlet Pink Salmon

Total pink salmon production is expected to be at 2.14 million fish from both wild and hatchery production. The harvest is forecast to be 1.82 million, although there may be some harvest of stock originating outside the streams studied for the forecast, that may cause the actual catch to go higher.

## Kodiak Pink and Sockeye Salmon

Pink salmon returns are expected to be slightly below average in the Kodiak area, barring major unforeseen effects of the M/V *Exxon Valdez* oil spill. In 1988 we saw excellent escapement, yet the 1989 fry index was below average. Sockeye salmon runs into Upper Station and Frazer Lake are expected to be lower than those in 1989. The run into Ayukulik River is expected to be higher. Harvests from these four forecast systems are expected to total near 1.4 million sockeye salmon, out of an expected 2.3 million sockeye salmon to be harvested in the Kodiak area.

## Chignik Sockeye Salmon

The total Chignik run is forecast to be 1.82 million sockeye salmon, with an expected catch of 1.17 million. The early run is expected to be much lower than average, while the late run is expected to be only slightly lower than average.

## Bristol Bay Sockeye and Chinook Salmon

In 1990, 26.7 million sockeye salmon are expected to return to Bristol Bay. This is expected to result in a harvest of 14.7 million inshore, and 1.3 million south of the Alaska Peninsula. This would be about 34% less than the average of the previous 10 years. An expected 115.6 thousand chinook salmon are to return to Bristol Bay in 1990. This is expected to result in a harvest of 40.6 thousand, slightly less than the recent 5-year average. Nushagak District chinook salmon runs have been declining recently for reasons not yet understood.

## OUTLOOK FOR THE 1990 ALASKA COMMERCIAL SALMON HARVESTS

The Alaska Department of Fish and Game does not produce formal forecasts for all salmon runs in the state, although local managers do prepare harvest outlooks, or harvest projections for all areas. The harvest projections are based on formal forecasts, when available; otherwise historical catches and local knowledge of recent events are used to develop the harvest outlooks. Below are these projections for the 1990 Alaska commercial salmon harvest by species, and by statistical region, as well as by management region, and in some cases by finer divisions. These projections are presented in Tables 9 and 10, respectively. The harvest outlooks for AYK Region are developed as ranges. A table of these ranges is found in Appendix B.1. Coho salmon runs are not forecasted in any region. Forecasts of chum salmon runs are available only for Prince William Sound. Several smaller pink salmon returns are not forecasted. Major sockeye salmon runs in the Central and Western statistical regions are forecasted. Despite these gaps, 81% of the 1989 salmon harvest came from fisheries where formal run forecasts have been developed for the 1990 fishery.

The 1990 total commercial harvest projection is for 108.2 million salmon: 612 thousand chinook salmon, 29.3 million sockeye salmon, 4.84 million coho salmon, 62.6 million pink salmon, and 10.8 million chum salmon.

## Species Outlook

*Chinook Salmon.* The harvest of chinook salmon is expected to increase slightly in 1990. The expected harvest is 612 thousand which compares with the 1989 harvest of 583.4 thousand chinook salmon, and with the record harvest of 878 thousand which occurred in 1982. Some of the increase from 1989 is expected to come from increases in hatchery cost recovery and hatchery terminal harvests.

*Sockeye Salmon.* The 1990 sockeye salmon harvest is expected to be 29.3 million fish, a drop from 1989's harvest of 44.6 million, and less than every harvest since 1979. Bristol Bay is expected to produce an inshore harvest of 14.7 million sockeye salmon in 1990.

Table 9. Preliminary projections of 1990 Alaska commercial salmon harvests by statistical region and species in thousands of fish.

Fishing Area	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Statistical Region	297 1/	1,600	2,000	9,600	2,900	16,397
Cordova Area	37	733	896	26,200	1,480	29,346
Upper Cook Inlet	25	4,300	250	600	400	5,575
Lower Cook Inlet	2	485	10	1,814	60	2,371
Kodiak Area	8	2,300	190	11,790	705	14,993
Chignik	4	1,170	160	1,960	152	3,446
South Peninsula	10	2,000	300	8,250	1,300	11,860
Central Statistcial Region	86	10,988	1,806	50,614	4,097	67,591
North Peninsula	15	1,900	200	50	200	2,365
Aleutian Islands	0	5	0	500	0	505
Bristol Bay Area	41	14,700	175	1,800	1,300	18,016
A.Y.K. Region	173	124	664	44	2,345	3,350
Western Statistical Region	229	16,729	1,039	2,394	3,845	24,236
<b>TOTAL ALASKA</b>	<b>612</b>	<b>29,317</b>	<b>4,845</b>	<b>62,608</b>	<b>10,842</b>	<b>108,224</b>

1/ Includes 56 thousand in hatchery terminal harvest and cost recovery harvest.

Revised February 20, 1990, catches in thousands of fish. The projected 1990 harvests were obtained by summing harvest forecasts (Table 8) and harvest projections for remaining fisheries.

See Tables 4,5,6, and 7 for definition of management regions.

Table 10. Preliminary projections of 1990 Alaska commercial salmon harvests by fishing area and species in thousands of fish.

Fishing Area	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Region	297 1/	1,600	2,000	9,600	2,900	16,397
Cordova Area	37	733	896	26,200	1,480	29,346
Upper Cook Inlet	25	4,300	250	600	400	5,575
Lower Cook Inlet	2	485	10	1,814	60	2,371
Bristol Bay Area	41	14,700	175	1,800	1,300	18,016
Central Region	105	20,218	1,331	30,414	3,240	55,308
Kodiak Area	8	2,300	190	11,790	705	14,993
Chignik	4	1,170	160	1,960	152	3,446
South Peninsula	10	2,000	300	8,250	1,300	11,860
North Peninsula	15	1,900	200	50	200	2,365
Aleutian Islands	0	5	0	500	0	505
Westward Region	37	7,375	850	22,550	2,357	33,169
A.Y.K. Region	173	124	664	44	2,345	3,350
TOTAL ALASKA	612	29,317	4,845	62,608	10,842	108,224

1/ Includes 56 thousand in hatchery terminal harvest and cost recovery harvest.

Revised February 20, 1990, catches in thousands of fish. The projected 1990 harvests were obtained by summing harvest forecasts (Table 8) and harvest projections for remaining fisheries.

See Tables 4,5,6, and 7 for definition of management regions.

*Coho Salmon.* Coho salmon harvests in the state have increased greatly since the mid 1970's. In 1975 the statewide harvest was slightly over 1 million; since 1980, harvests have been between 3.1 to 6.2 million fish. The 1990 projection is for a harvest of 4.84 million coho salmon. In Southeast Alaska 2.0 million coho salmon are expected to be harvested. An increase in hatchery production of coho salmon is expected in Prince William Sound.

*Pink Salmon.* The 1990 harvest projection is for 62.6 million pink salmon. This harvest would be slightly less than recent even year averages. Prince William Sound is expecting a small wild run after the poor return in 1988. In Southeast Alaska, even year pink salmon production is expected to be poor also. Elsewhere in the state, the outlook for pink salmon generally is favorable.

*Chum Salmon.* Chum salmon harvest is expected to be 10.8 million fish in 1990. This is slightly below recent averages.

## LITERATURE CITED

- Alaska Department of Fish and Game. 1969. A summary of preliminary 1970 salmon forecasts for Alaskan fisheries. Informational Leaflet 136. 52 pp.
- \_\_\_\_\_. 1970. A summary of preliminary 1971 forecasts for Alaskan salmon fisheries. Informational Leaflet 149. 35 pp.
- \_\_\_\_\_. 1971. A summary of preliminary 1972 forecasts for Alaska salmon fisheries. Informational Leaflet 155. 42 pp.
- \_\_\_\_\_. 1972. A summary of preliminary 1973 forecasts for Alaskan salmon fisheries. Informational Leaflet 160. 44 pp.
- \_\_\_\_\_. 1973. A summary of preliminary 1974 forecasts for Alaskan salmon fisheries. Informational Leaflet 164. 47 pp.
- \_\_\_\_\_. 1975. A summary of preliminary 1975 forecasts for Alaskan salmon fisheries. Informational Leaflet 167. 55 pp.
- \_\_\_\_\_. 1976. A summary of preliminary 1976 forecasts for Alaskan salmon fisheries. Informational Leaflet 169. 49 pp.
- \_\_\_\_\_. 1977. Preliminary forecasts and projections for 1977 Alaskan salmon fisheries. Informational Leaflet 171. 39 pp.
- \_\_\_\_\_. 1978. Preliminary forecasts and projections for 1978 Alaskan salmon fisheries. Informational Leaflet 173. 36 pp.
- \_\_\_\_\_. 1979. Preliminary forecasts and projections for 1979 Alaskan salmon fisheries. Informational Leaflet 177. 37 pp.
- \_\_\_\_\_. 1980. Preliminary forecasts and projections for 1980 Alaskan salmon fisheries. Informational Leaflet 183. 37 pp.
- \_\_\_\_\_. 1981. Preliminary forecasts and projections for 1981 Alaskan salmon fisheries. Informational Leaflet 190. 38 pp.
- \_\_\_\_\_. 1982. Preliminary forecasts and projections for 1982 Alaskan salmon fisheries. Informational Leaflet 197. 39 pp.
- \_\_\_\_\_. 1983. Preliminary forecasts and projections for 1983 Alaskan salmon fisheries. Informational Leaflet 209. 41 pp.
- \_\_\_\_\_. 1984. Preliminary forecasts and projections for 1984 Alaskan salmon fisheries. Informational Leaflet 244. 53 pp.
- Efron, B., and G. Gong. 1983. A leisurely look at the Bootstrap, the Jackknife, and Cross-Validation. *The American Statistician*, 37:1 pp 36-48.



### LITERATURE CITED (Continued)

Eggers, D.M. 1985. Preliminary forecasts and projections for 1985 Alaska salmon fisheries. Informational Leaflet 244. 53 pp.

\_\_\_\_\_. 1986. Preliminary forecasts and projections for 1986 Alaska salmon fisheries. Informational Leaflet 253. 55 pp.

Eggers, D.M. and M.R. Dean. 1987. Preliminary forecasts and projections for 1987 Alaska salmon fisheries. Informational Leaflet 259. 52 pp.

\_\_\_\_\_. 1988. Preliminary forecasts and projections for 1988 Alaska salmon fisheries. Regional Information Report 5J88-1. 60 pp.

Geiger, H.J. and H.M. Savikko. 1989. Preliminary forecasts and projections for 1989 Alaska salmon fisheries. Regional Information Report 5J89-01. 60 pp.

APPENDICES A THROUGH B  
RUN FORECAST METHODS AND DISCUSSIONS  
AND A-Y-K HARVEST PROJECTIONS BY AREA

## APPENDIX A.1 SOUTHEAST ALASKA PINK SALMON

FORECAST AREA: Southeast Alaska

SPECIES: Pink

PRELIMINARY FORECAST OF 1990 RUN:

NATURAL PRODUCTION:

Southern Southeast:	<u>Point</u>	<u>Range</u>
Run Estimate:	13.1 million	8.5 - 20.1 million
Escapement Goal:	6.0 million <sup>1</sup>	
Harvest Estimate:	7.1 million	2.5 - 14.1 million

Northern Southeast:

Run Estimate:	6.8 million	3.5 - 13.2 million
Escapement Goal:	4.8 million	
Harvest Estimate:	2.0 million	0 - 8.4 million

SUPPLEMENTAL PRODUCTION:

Southern Southeast Run Estimate:	.1 million
Northern Southeast Run Estimate:	.4 million

TOTAL SOUTHEAST PRODUCTION:

Run Estimate:	20.4 million
Escapement Goal:	10.8 million <sup>1</sup>
Harvest Estimate:	9.6 million

---

<sup>1</sup> In order to achieve a good escapement distribution to all systems in Southern Southeast, it is anticipated that we will need to put an additional 2 to 3 million pink salmon into the escapement which will reduce the harvest estimate by the same amount.

#### FORECAST METHODS:

Runs to the Southern and Northern areas of Southeast Alaska are forecast separately because of differences in migration routes and run timing.

The Southern Southeast run forecast is based on a multiple linear regression analysis of 20 years of data (return years 1967 through 1986). Variables utilized in the regression analysis included brood year escapement index, and average daily minimum air temperatures from five stations in Southern Southeast during the November 1<sup>st</sup> through February 28<sup>th</sup> time period.

Multiple linear regression analysis was also utilized to forecast Northern Southeast's run. Independent variables utilized in the regression included brood year escapements, and the average length of fry collected during the early marine program in Tenakee Inlet.

#### FORECAST DISCUSSION:

Southern Southeast: It should be emphasized that 1989 was the third consecutive year in which the pink salmon run to Southern Southeast came in outside of the prediction range. An extensive search for environmental parameters to account for the errors was unsuccessful. It is very possible that high seas survival is no longer as constant as it apparently was between 1967 and 1986 (the time period over which inshore parameters adequately describe variations in pink salmon runs). At present, no data is available to confirm the above; or determine if the suspected change is the result of natural environmentally induced survival changes, high seas interception, or an interaction of the two. Because of the above, this forecast should be viewed with more than the normal degree of skepticism.

The 1988 escapement index of 4.1 million was the lowest achieved in the last 12 years. Winter temperatures were very close to average (29.1 compared to a 23-year average of 28.6). The only environmental parameter found which was outside of the range of study period experience (1967 to 1989) was precipitation. A major storm which moved through Southeast in November resulted in more rain over a two day period than any other storm since N.O.A.A. record keeping was initiated in 1947. The total mortality resulting from this flood can not be measured; however, pre-emergent pumping conducted by F.R.E.D. Division on a McDonald Lake stream indicated that at least that stream had a major mortality caused by eggs being washed out of the gravel. Another major concern was that the number of fry observed during the 1989 early marine program was well below that observed in 1988. This decline was especially apparent on the west coast of Prince of Wales Island. However, abundance was greater than that observed in 1986 when beach seines had to be doubled in length in order to obtain adequate

Appendix A.1 (p 3 of 3)

sample sizes for the condition index program. A final concern is that the escapement distribution in 1988 was very poor. Districts 101 through 104 had escapement indices only slightly below goals while districts 105 through 108 were all well below goals. Consequently no pink salmon directed seine harvesting should be expected in districts 105 through 107 in 1990.

If the three outlier years (1987 through 1989) were not omitted from the regression the mid point of the prediction raises to 19.0. Because of the large errors which result from including the outlier years, the prediction interval increases in size, 8.4 to 42.3 million. The average error per year disregarding sign in hindcasting for the 1967 through 1986 time period raises from 4.7 to 7.2 when the three outlier years are included.

Northern Southeast: This is the first year that fry length data from the Tenakee Inlet early marine program are being utilized for predictions. The correlation between fry length or weight in May and apparent survival as measured by return per index spawner was noted in earlier years but not included in the official prediction because of the relatively short data base. We now have nine years of comparative data, and the correlation continues to remain strong ( $r = .91$ , 7 degrees of freedom). Because early marine fry data are being utilized, the number of years incorporated into the regression formula had to be reduced to 8 (return years 1982 through 1989). Comparative fry data are only available back to 1981.

A second potential independent variable for the 1990 prediction is the escapement index. The escapement index exhibits almost no correlation with run over the 8 years under consideration (partial correlation  $r = .02$ ). The brood year escapement index for the 1990 run of 2.7 million was the lowest escapement index achieved since 1982. The fry length parameter was slightly below average at 41.4 mm compared to a study period average of 43.0 mm.

Karl T. Hofmeister  
Fishery Biologist  
Ketchikan

**APPENDIX A.2 PRINCE WILLIAM SOUND PINK AND CHUM SALMON,  
COGHILL RIVER SOCKEYE SALMON, AND PRINCE WILLIAM SOUND COHO SALMON**

FORECAST AREA: Prince William Sound

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF THE 1990 RUN:

Natural Production:

	Estimate (millions)	Range (millions)
Total Run	3.80	1.50 - 10.00
Escapement Goal	1.35	
Harvest	2.45	0.15 - 8.65

Supplemental Production:

VFDA - Solomon Gulch Hatchery

	Estimate (Millions)	Range (Millions)
Total Run	5.02	2.77 - 7.28
Brood Stock Needs	0.22	
Sales Harvest Goal	1.42	
Commom Property Harvest	3.38	1.13 - 5.64

PWSAC - Armin F. Koernig Hatchery

	Estimate (Millions)	Range (Millions)
Total Run	8.58	7.23 - 9.93
Brood Stock Needs	0.21	
Sales Harvest Goal	2.24	
Commom Property Harvest	6.13	4.78 - 7.49

PWSAC - Wallace H. Noerenburg Hatchery

	Estimate (Millions)	Range (Millions)
Total Run	8.55	7.20 - 9.90
Brood Stock Needs	0.35	
Sales Harvest Goal	2.24	
Commom Property Harvest	5.96	4.61 - 7.31

Appendix A.2 (p 2 of 11)

PWSAC - Cannery Creek Hatchery

	Estimate (Millions)	Range (Millions)
Total Run	2.66	2.03 - 3.30
Brood Stock Needs	0.28	
Sales Harvest Goal	0.73	
Commom Property Harvest	1.65	1.02 - 2.30
Total Supplemental Production		
	Estimate (Millions)	Range (Millions)
Total Run	24.81	19.23 - 30.40
Brood Stock Needs	1.06	
Sales Harvest Goal	6.63	
Commom Property Harvest	17.66	11.54 - 22.71
Combined Natural and Supplemental Production:		
	Estimate (Millions)	Range (Millions)
Total Run	28.61	20.73 - 40.40
Natural Escapement Goal	1.35	
Brood Stock Needs	1.06	
Sales Harvest Goal	6.63	
Commom Property Harvest	19.57	11.69 - 31.36

FORECAST METHODS:

The forecast for natural runs is based on a linear regression of the pre-emergent fry index versus log transformed total runs. The development of the reasoning behind the pre-emergent fry index (I) is developed below.

Let:

$F_{ij}$	=	Number of fry in tide zone i of stream j
$m_{ij}^2$	=	Square meters sampled in zone i of stream j.
S	=	Number of index streams sampled.
Z	=	Number of tide zones sampled.

Appendix A.2 (p 3 of 11)

Then define  $A_{ij}$  and  $A_i$  as follows:

$$A_{ij} = \frac{\sum F_{ij}}{m_{ij}^2}$$

$$A_i = \frac{\sum A_{ij}}{S}$$

Then  $I$  is calculated in the following manner:

$$I = \frac{\sum A_i}{Z}$$

The range ( $R$ ) about the natural stock run forecast is the 80% confidence interval around the cross-validation regression (Effron 1983) results which was calculated as follows.

Let:

- $P$  = 1990 Forecast point estimate;
- $N$  = Number of years of observations;
- $O_i$  = Observed run in year  $i$ ;
- $E_i$  = Forecasted run in year  $i$  using using all  $N$  years, except year  $i$ ; and
- $t$  = The 100%-(80%/2) percentile of the Student's  $t$  distribution on  $N$  degrees of freedom.

Then:  $R = P \pm ((\sum (O_i - E_i)^2)/N)^{1/2} t$  (A.2.1)

The run forecast for hatchery runs is the sum of hatchery specific forecasts. For each hatchery, the forecast is the product of the number of fry released and the average hatchery specific marine survival. Marine survival is the mean marine survival for all years of production for the hatchery. The prediction interval around the forecast is derived from the confidence interval around the mean of the marine survival data. Unfortunately, these marine survival data are suspect. For most years in the historic data base for PWS hatcheries, marine survival estimates are probably little more than best guesses. Total runs were estimated as the sum of hatchery terminal area harvests and brood stock divided by some educated guess of the exploitation rate on all stocks in the common property fisheries. The accuracy of these estimates are unknown, and there are no associated variances. Since 1987 some run estimates are based on coded wire tag recovery data. Confidence in this data is greater, but there are only two years of data for each facility.

The projected brood stock needs for each facility are fairly accurate. The sales harvest numbers are very preliminary and may vary depending on changes in projected operating costs, the final value for the 1989 sales



harvests, the revenue generated for PNP's from the 2% assessment on area salmon harvests for 1989 and, the projected prices for 1990.

The escapement, brood stock, and sales harvest requirements are treated as constants; and the confidence interval for the common property harvest is the same as for the total run.

#### FORECAST DISCUSSION:

The projected 3.8 million wild stock pink salmon run in 1990 would be the fourth smallest even year run since statehood and is well below the even year average. The small run forecast is driven in large part by the 1989 pre-emergent fry index which was the second smallest recorded for even brood years. Despite mild temperatures in the spring of 1989, there is no reason to suspect that this will positively affect marine survival of the emergent fry from the 1988 brood year. Marine survival appears to be related to average March and April air temperatures in the odd year forecast but not in the even years.

The point estimate of 24.8 million fish returning to hatcheries in 1990 is slightly smaller than the forecasted runs in 1989 but is still the largest even year hatchery prediction on record. This apparent drop in production is a function of smaller fry releases from WHN and Cannery Creek hatcheries in 1989 compared to 1988. The 1990 run forecast is also based on hatchery specific marine survival data rather than the blanket 5.3% survival figure used to forecast 1989 runs. The mean marine survival rate for AFK is in fact 5.3%, and this rate is also assumed to be true for WHN hatchery. The mean survival rates for Solomon Gulch and Cannery Creek hatcheries (3.7% and 4.5% respectively) are considerably lower. The reasons for the lower survivals in these two facilities are unknown.

Appendix A.2 (p 5 of 11)

PRINCE WILLIAM SOUND CHUM SALMON

1990 Forecast

Natural Production:	Estimate (Thousands)	Range (Thousands)
Total Run	415.7	243.3 - 710.1
Natural Escapement Goal	225.5	
Harvest	190.2	17.8 - 484.6

Supplemental Production:

VFDA - Solomon Gulch Hatchery

	Estimate (Thousands)	Range (Thousands)
Total Run	46.8	35.9 - 57.6
Brood Stock Needs	20.0	
Sales Harvest Goal	0.0	
Common Property Harvest	26.8	15.9 - 37.6

PWSAC - Armin F. Koernig Hatchery

	Estimate (Thousands)	Range (Thousands)
Total Run	7.3	5.6 - 8.9
Brood Stock Needs	0.0	
Sales Harvest Goal	0.0	
Common Property Harvest	7.3	5.6 - 8.9

PWSAC - Wallace H. Noerenburg Hatchery (Early Stock)

	Estimate (Thousands)	Range (Thousands)
Total Run	340.3	261.3 - 419.3
Brood Stock Needs	102.9	
Sales Harvest Goal	0.0	
Common Property Harvest	237.4	158.4 - 316.4

Appendix A.2 (p 6 of 11)

PWSAC - Wallace H. Noerenburg Hatchery (Late Stock)

	Estimate (Thousands)	Range (Thousands)
Total Run	181.2	139.1 - 223.3
Brood Stock Needs	10.4	
Sales Harvest Goal	63.8	
Common Property Harvest	107.0	64.9 - 149.1

ADF&G/F.R.E.D. Division - Main Bay Hatchery

	Estimate (Thousands)	Range (Thousands)
Total Run	847.3	650.5 - 1,044.1
Brood Stock Needs	0.0	
Sales Harvest Goal	0.0	
Common Property Harvest	847.3	650.5 - 1,044.1

Total Supplemental Production:

	Estimate (Thousands)	Range (Thousands)
Total Run	1,422.9	1,092.4 - 1,753.2
Brood Stock Needs	133.3	
Sales Harvest Goal	63.8	
Common Property Harvest	1,225.8	895.3 - 1,556.1

Combined Natural and Supplemental Production:

	Estimate (Thousands)	Range (Thousands)
Total Run	1,838.6	1,335.7 - 2,463.3
Natural Escapement Goal	225.5	
Brood Stock Needs	133.3	
Sales Harvest Goal	63.8	
Common Property Harvest	1,416.0	913.1 - 2,040.7

FORECAST METHODS:

The natural stock run forecast is the pooled results of three separate regressions in which the runs of 3- and 4-year old fish are predicted from pink runs from the same brood year and 5-year-old fish are predicted from sibling 4-year old runs in 1989. To calculate the prediction interval the runs for years 1974 through 1988 were predicted by using a cross-validation procedure as described above for pink salmon in equation A.2.1.

## Appendix A.2 (p 7 of 11)

The hatchery runs for 1990 are projected from fry releases in 1986, 1987 and 1988, an estimated marine survival of 1.55%, and average age composition for natural chum runs from brood years 1978 through 1982. The marine survival rate is based on four years of fry release and adult run data from the ADF&G Main Bay hatchery. This is the only hatchery for which formal quantitative methods (coded wire tagging results) were used to estimate the portion of the adult returns intercepted in the commercial harvest -- hence the only one with reliable total run estimates.

### FORECAST DISCUSSION:

The forecast for natural chum runs in 1990 is only 39% of the 1974 to 1989 average. The low forecast is driven by poor runs of pink salmon from the 1986 and 1987 brood years. These regressions based on "siblings" of another species may seem suspect but are corroborated by similar predictions based on regressions between chum salmon sibling age groups. Intra-species models for sibling age groups have been used in some prior years to forecast but explain less of the variability in runs of 3-year-old and 4-year-old fish than the sibling pink salmon models.

Despite the lower than average run forecast for natural stocks, the overall harvest of chums in 1990 should exceed the 1974 - 1988 average by almost 490,000 fish because of full production levels from the area hatcheries. The Main Bay hatchery, which previously produced chum salmon, is no longer doing so; but large fry releases at that facility in 1986 and 1987 will produce 1990 runs of approximately 847,000 fish. In the absence of brood stock requirements, these runs can be fully exploited. The WHN facility is not yet at peak production capacity with respect to chum salmon but expects a total run of approximately 520,000 fish in 1990. From these runs, the stock with early run timing will contribute approximately 240,000 fish to the common property fisheries, and the stock with late run timing will contribute approximately 110,000 fish. The relatively small 47,000 fish run to Solomon Gulch will contribute approximately 27,000 fish to the common property fisheries.

Appendix A.2 (p 8 of 11)

PRINCE WILLIAM SOUND COGHILL DISTRICT SOCKEYE SALMON

1990 Forecast

Natural Production - Coghill Lake:

	Estimate (Thousands)	Range (Thousands)
Total Run	50.3	15.8 - 160.1
Natural Escapement Goal	50.0	
Hatchery Brood Stock	4.5	
Harvest	0.0	0.0 - 105.6

Supplemental Production:

ADF&G/F.R.E.D. Division - Main Bay Hatchery

	Estimate (Thousands)	Range (Thousands)
Total Run	9.9	8.9 - 10.9
Brood Stock Needs	0.0	
Sales Harvest Goal	0.0	
Common Property Harvest	9.9	8.9 - 10.9

Combined Natural and Supplemental Production:

	Estimate (Thousands)	Range (Thousands)
Total Run	60.2	24.7 - 171.0
Natural Escapement Goal	50.0	
Hatchery Brood Stock	4.5	
Sales Harvest Goal	0.0	
Common Property Harvest	9.9	8.9 - 116.5

FORECAST METHODS:

The forecast for the Coghill Lake runs is the pooled results of 4 separate regressions. The runs of 4-year-old fish aged 1.2 are predicted from regressing the log of the returns of fish aged 1.1 in the prior year on the log of the returns of sibling fish aged 1.2. The returns of 5-year-old fish aged 1.3 are predicted from similar sibling model using returns of fish aged 1.2 from the prior year. The mean return-at-age is used to predict 5-year-old fish aged 2.2 and 6-year-old fish aged 2.3.

## Appendix A.2 (p 9 of 11)

Although catch and escapement at age exist for the Coghill sockeye runs from as far back as 1962, escapement data prior to the installation of the full weir in 1974 are unreliable. Escapement and catch at age data in the regressions are from 1974 to the present. To calculate the prediction interval, a cross-validation procedure was used as described for pink salmon in equation A.2.1.

The forecast for Main Bay Hatchery runs is based on a marine survival rate of 20% for smolt released in 1988. This run of 4-year-old fish is the first adult run to the facility, and the 20% survival rate is only a best guess based on data from other areas. In the absence of historic data, the forecast interval is the estimated run for 18% and 22% (runs expected at plus or minus 10% of marine survival used for point estimate). It is anticipated that most of the runs to the hatchery will be intercepted in the Coghill gill net fishery and brood stock will be collected from terminal runs only if available.

### FORECAST DISCUSSION:

The forecasted total run of approximately 50,000 sockeye salmon to Coghill Lake in 1990 is the lowest forecast on record. Given the 50,000 -60,000 fish escapement goal for Coghill Lake, it is unlikely there will be any fishery for sockeye salmon in the Coghill District in 1990. The poor forecast is driven largely by the extremely poor runs of 4-year-old fish (age 1.2) in 1989. The runs fell well outside of the range of the historic data base used to construct the sibling forecast model for runs of fish aged 1.3 which are the dominant age group (70% historic average) for this stock. Because the independent variable used in the forecast regression is out of the range the results of the regression are suspect. Nevertheless, the indications of a virtual run failure for 1990 cannot be ignored. In the absence of any other workable forecast models for this dominant age group, the forecast based on the sibling run model stands.

The brood stock needs shown in the forecast summary are for conversion of the Main Bay Hatchery from a chum salmon hatchery to a sockeye salmon hatchery.

PWS COHO SALMON HATCHERY FORECASTS AND NATURAL STOCK CATCH PROJECTION

1990 Forecast

Supplemental Production

VFDA - Solomon Gulch Hatchery

	Estimate (Thousands)	Range (Thousands)
Total Run	101.0	86.3 - 115.7
Brood Stock Needs	0.6	
Sales Harvest Goal	30.0	
Common Property Harvest	70.4	55.7 - 85.1

PWSAC - Wallace H. Noerenburg Hatchery

	Estimate (Thousands)	Range (Thousands)
Total Run	375.2	344.0 - 406.3
Brood Stock Needs	1.5	
Sales Harvest Goal	0.0	
Common Property Harvest	373.7	342.5 - 404.8

Total Supplemental Production

	Estimate (Thousands)	Range (Thousands)
Total Run	476.2	430.3 - 522.0
Brood Stock Needs	2.1	
Sales Harvest Goal	30.0	
Common Property Harvest	444.1	398.2 - 489.9

FORECAST METHODS:

The point estimates are the product of the number of smolt released from each facility in 1989 and the average marine survival for each facility. The forecast range is based on the 80% confidence interval about the mean of marine survival.

FORECAST DISCUSSION:

The mean marine survival rates for Solomon Gulch and WHN Hatcheries are 10.2% and 15.0% respectively. The validity of these rates is unknown. The former agrees well with average marine survival rates reported from

Appendix A.2 (p 11 of 11)

hatcheries in other areas, the latter is considerably higher. The former is based on only four years of data, the latter on only three years of data but the variance is small. The natural stock production in PWS is small and in recent years fisheries have been confined to a large degree to hatchery terminal areas. Total run estimates, hence marine survival estimates, for hatchery stocks are probably fairly reliable.

1990 Natural Stock Harvest Projection

	Estimate (Thousands)	Range (Thousands)
Common Property Harvest	10.2	7.3 - 13.2

HARVEST PROJECTION METHODS:

The harvest projection is the mean of the historic coho salmon harvest in PWS from 1968 to 1984. In years subsequent to 1984 there has been hatchery production of coho salmon in PWS, and the natural component of the catch is unknown. The harvest projection range is the 80% confidence interval about the 1968 - 1984 harvest mean.

Sam Sharr  
Research Project Leader  
Cordova



### APPENDIX A.3 PRINCE WILLIAM SOUND/COPPER RIVER SOCKEYE AND CHINOOK SALMON

FORECAST AREA: Prince William Sound/Copper River

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF 1990 RUN:

NATURAL PRODUCTION	Estimate	Range
Run Estimate:	1,138,400	970,100 to 1,306,700
Harvest Estimate:	517,400	431,300 to 603,500
Escapement Goal:	621,000	

SUPPLEMENTAL PRODUCTION

Gulkana Hatchery

Run Estimate:	234,000	188,000 to 281,000
Harvest Estimate:	140,700	113,000 to 169,000
Brood Stock and Stream Escapement	93,800	

TOTAL PRODUCTION

Run Estimate:	1,373,000	1,205,000 to 1,541,000
Harvest Estimate:	658,000	572,000 to 744,000
Escapement and Brood Stock:	715,000	

FORECAST METHODS:

Natural Production: The 1990 sockeye salmon run forecast utilized historical return per spawner data from the seven most similar spawning populations and parent year escapement weighted by age class (4-, 5- and 6-year-olds) for the Copper River Delta and Upper Copper River independently. The 1990 predicted run is influenced heavily by the 1985 brood year for the Copper River Delta and the Upper Copper River.

Supplemental Production: The 1990 supplemental run will be the result of production from Gulkana hatchery. Brood years 1985 and 1986 using F.R.E.D. Division standard survival assumptions should produce an adult run of 234,000. An exploitation rate of 60% would contribute 141,000 salmon to the commercial catch.

FORECAST DISCUSSION:

Natural Production: Continued relatively mild winter conditions, particularly on the Copper River Delta, existed during the freshwater life stage. Yet, the age groups represented in the 1990 run should produce a below average return per spawner contribution from the above average parent year escapements of 1984 and 1985 and below average escapement in 1986. Upper Copper River escapements were near or above average in all three years, thus generally mild conditions and good distribution should yield near average runs. Some of the parent year escapements are among the highest in the available data base, thus few similar prediction points are available. The run forecast will be low if environmental conditions continue to produce above average survival rates; however, high fry densities may reduce the return per spawner.

Supplemental Production: Lack of facility production data and unstable conditions suggest that the egg to adult survival is uncertain. Thus the 1990 total sockeye run is also uncertain. However, as future data is collected, predictions are expected to become more reliable.

Appendix A.3 (p 3 of 3)

SPECIES: Chinook Salmon

PRELIMINARY FORECAST OF THE 1990 RUN:

NATURAL PRODUCTION	Estimate	Range
Run Estimate:	52,100	42,600 to 61,600
Harvest Estimate:	37,100	28,200 to 46,000
Escapement Goal:	15,000	

FORECAST METHODS:

The 1990 chinook salmon run forecast utilized historical aerial index and age composition data from the 4-, 5-, 6- and 7-year-old age classes. Weighted indexes are combined to create a single index of abundance which, for lack of better data, is compared to the historical average escapement index. The expected run comes from the estimated average return per spawner which does not consider relative density, climate conditions, or distribution of spawners.

FORECAST DISCUSSION:

During the past six years, chinook salmon runs to the Copper River have been consistently above average and have established several of the top catches on record. Escapements have also been maintained at high levels.

Only a failure of the 1984 or 1985 brood years or significant extra production from the 1986 brood year could seriously affect the forecasted run. No climate condition or other event are believed to have significantly impacted any of the brood years involved. A chinook salmon harvest of the 37,100 fish magnitude appears to be a solid prediction.

Kenneth Roberson  
Research Biologist  
Glennallen

#### APPENDIX A.4 UPPER COOK INLET SOCKEYE SALMON

FORECAST AREA: Upper Cook Inlet

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF 1990 RUN:

NATURAL PRODUCTION	<u>Estimate</u>	<u>Range</u>
Run Estimate:	5.8 million	3.7 million - 9.7 million
Escapement Goal:	1.5 million	
Harvest Estimate:	4.3 million	2.2 million - 8.2 million

#### FORECAST METHODS:

The major sockeye salmon systems in Upper Cook Inlet are the Kenai, Kasilof, Susitna, Crescent, Chakachatna/McArthur, and Big Rivers and Fish Creek.

The basis of the 1990 forecast is different from previous years. The relatively poor relationship between the number of adult spawners and the number of returning adults has resulted in significant forecast error. Therefore, historical harvest data was subjected to a Box Jenkins AR1 model. This time series approach appears to provide a better forecast tool than the classic escapement to return relationships used previously. However, this does not allow individual river system forecasts. Therefore, to supplement this approach, biological data on fry and smolt production, runs to individual rivers, and age composition data were used to subjectively identify production by river system. The reader is cautioned that significant error by river system is possible.

#### FORECAST DISCUSSION:

The estimated harvest of sockeye salmon in Upper Cook Inlet for 1990 is 4.3 million fish. Escapement objectives remain the same as 1989 at 1.5 million adult sockeye salmon. Run by river system was not calculated, but indications from biological data are that the Kenai River system will predominate in the harvest. Anticipated 1990 runs to the Kasilof and Susitna Rivers should approximate 560,000 and 380,000 fish, respectively. The Fish Creek run, based on smolt data, should be in the range of 130,000 fish while adult sockeye salmon returning to Crescent River should approach 150,000 fish.

Kenneth E. Tarbox  
Research Project Leader  
Upper Cook Inlet

## APPENDIX A.5 LOWER COOK INLET PINK SALMON

FORECAST AREA: Lower Cook Inlet

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF THE 1990 RUN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Total Run	692,000	210,000 - 2,313,000
Escapement Goal <sup>1</sup>	372,000	275,000 - 470,000
Harvest Estimate <sup>2,3</sup>	415,000	72,000 - 1,877,000
SUPPLEMENTAL PRODUCTION		
Total Run	1,450,000	817,000 - 1,634,000
Brood Stock	50,000	
Harvest Estimate	1,400,000	767,000 - 1,584,000
TOTAL AREA PRODUCTION		
Total Run	2,142,000	1,027,000 - 3,947,000
Brood Stock and Escapement	422,000	325,000 - 520,000
Harvest Estimate	1,815,000	839,000 - 3,461,000

---

<sup>1</sup> Escapement goal is 372,000 for systems with a formal forecast. The total Lower Cook Inlet pink salmon escapement goal for all systems with or without a formal forecast is 489,000.

<sup>2</sup> For systems with a formal forecast only. Additional harvest may be expected in systems without a formal forecast.

<sup>3</sup> Among the systems with a formal forecast, at least four stocks are expected to have runs less than its escapement goal. Consequently, the expected escapement will be short of the escapement goal by 95,000. The harvest of 415,000 plus the escapement goal of 372,000 minus the escapement shortfall of 95,000 will add up to the forecast run.

## Appendix A.5 (p 2 of 2)

### FORECAST METHODS:

The 1990 pink salmon forecast run to the Lower Cook Inlet Management Area was derived from the log-log regression of returns on escapement based on data from 1960 to 1988. The 1990 harvest estimate was obtained by subtracting the escapement goal from the forecast run by individual bays and river systems. The sum of the harvest estimates for the individual bays and river systems would then be the total Lower Cook Inlet harvest estimate.

### FORECAST DISCUSSION:

Pink salmon escapements were generally poor in 1988 with the exception of the Kamishak District. If pink salmon survival conditions are good, the estimated harvest would be about 153,000 in Bruin Bay and 95,000 in the Ursus and Rocky Cove area. Additional harvest is expected in the following areas: Big and Little Kamishak Rivers, Amakdedori Creek, Iniskin, and Cottonwood Bays.

No pink salmon harvest is anticipated in the Eastern District because of poor runs.

In the Outer District the pink salmon harvest estimates are 1,000 in Dogfish Bay, 20,000 in Port Chatham, none in Windy and Rocky Bays, 42,000 in Port Dick, and 48,000 in the Desire Lake area of Nuka Bay.

In the Southern District, the pink salmon harvest estimates are 45,000 in Humpy Creek, 400,000 in Halibut Cove Lagoon, 1,000,000 in Tutka Lagoon, 10,000 in Seldovia, and none in Port Graham. Additional harvest may be expected in China Poot Bay and the Barabara Creek area.

Nick Dudiak  
F.R.E.D. Area Biologist

Tom Schroeder  
C.F. Area Management Biologist

Henry Yuen  
C.F. Research Biologist

Lower Cook Inlet Management Area

## APPENDIX A.6 KODIAK PINK SALMON

FORECAST AREA: KODIAK

SPECIES: Pink Salmon

YEAR OF Run: 1990

PRELIMINARY FORECAST OF THE 1990 RUN<sup>1/</sup>:

<u>Point Estimate:</u>	<u>Total Run</u>	<u>Escapement</u> <sup>2/</sup>	<u>Harvest</u>
Natural Production	12.8 million	3.9 million	8.9 million
Hatchery Production	<u>3.16 million</u>	<u>.27 million</u>	<u>2.89 million</u>
Total Production	<u>15.96 million</u>	<u>4.17 million</u>	<u>11.79 million</u>

Range Estimate:

Natural Production	11.8-13.8 million	3.9 million	7.9-9.9 million
Hatchery Production	<u>1.25-5.78 million</u>	<u>.27 million</u>	<u>.98-5.51 million</u>

### FORECAST METHODS:

The 1990 pink salmon forecast run to the Kodiak Management Area was determined as follows: A point estimate for the total management area natural run was calculated from a linear least squares regression analysis of the past 24 years pre-emergent fry data. Variables used in the analysis were the indexed live fry densities and the average combined departure from the norm of the April ambient air temperatures taken in Kodiak. The upper and lower ranges are the 80% confidence intervals.

### FORECAST DISCUSSION:

Pre-emergent fry sampling this spring (1989) indicated poor to excellent over-winter survival from the excellent brood year escapement of 4.4 million pink salmon. Sampling resulted in an unweighted live fry index of 204.3 live fry/m<sup>2</sup>. This fry index points to a slightly below average even-year run.

---

<sup>1/</sup> Hatchery production forecast is for Kitoi Bay Hatchery and was prepared by Tim Joyce. See Afognak District for additional description. All numerical values represent numbers of pink salmon.

<sup>2/</sup> With the exception of hatchery production, escapement values represent indexed escapement.

Appendix A.6 (p 2 of 3)

The main factors which probably contributed to the lower live fry density were the heavy rains Kodiak Island received in early November 1988, which resulted in scouring in some systems, and the record cold temperatures in mid-January 1989, which ranged from 0°F to -20°F, resulting in many frozen spawning areas.

Sampling conditions during March and April (1989) were cold, but generally very good as far as water flows were concerned. The lower than average live fry density combined with normal spring conditions are the main reasons for the lower than average forecast for the 1990 run.

At this time there is no knowledge of what effects, if any, the oil spill from the M/V *Exxon Valdez* had on the early marine survival of Kodiak's migrant pink salmon fry.

Afognak District: The pre-emergent fry index for this district is above average. Apparently heavy snowfall helped to insulate stream beds and prevent serious over-winter mortality because of freezing. A total of 2.1 million pink salmon are expected to return. The desired escapement goal is 250,000 pinks leaving 1.85 million pink salmon available for harvesting.

Afognak District Supplemental Production: The Kitoi Bay Hatchery total run point estimate is 3.16 million pink salmon from a release of 400,000 emergent fry and 80.1 million reared pink fry. Approximately 270,000 pink salmon are required to meet broodstock and escapement requirements, leaving 2.89 million pinks available for harvesting.

Westside District: Overall, live fry densities for this district are some of the lowest on record in recent years. Scouring as a result of flooding conditions appeared to reduce over-winter survival in Uganik, Terror, Uyak and Zachar Rivers. Over-winter survival in Little Browns, Baumans, and Red Rivers appeared to be reduced because of the extreme cold temperatures freezing spawning locations. Because of the above mentioned conditions, only 5.6 million pinks are expected to return to this district. The desired escapement goal is 2,250,000 pinks leaving 3.35 million pink salmon available for harvesting.

Alitak District: The live fry index for this district is below average. Once again scouring and freezing were factors reducing over-winter fry survival. In addition, brood year escapements into Dog Salmon and Deadman rivers met only minimum requirements; therefore, in 1990, 900,000 pink salmon are expected to return to this district. The desired escapement goal is 500,000 pinks leaving 400,000 pinks available for harvesting.

General District: The overall live fry density is average. Freezing temperatures and scouring appear to be the main reasons for the lower than expected live fry densities. Mild spring temperatures in this district should help with improved early marine survival. A total of 2.1 million pink salmon are expected to return. The desired escapement goal is 500,000 pinks leaving 1.6 million pinks available for harvesting.



Mainland District: Fry sampling was limited to nine streams due to high winds and the end of the helicopter contract. With the exception of Kukak River, which was sampled in a new location, over-winter fry survival appeared to be very good showing much less damage from scouring or freezing than that which occurred on Kodiak Island. Considering the excellent brood year pink escapements from Dakavak south to Wide Bay, 2.1 million pinks are expected to return to this district. The escapement goal is 400,000 pinks leaving 1.7 million pinks available for harvesting.

Prepared by:

David Prokopowich  
Assistant Area Management Biologist  
Kodiak Management Area

**APPENDIX A.7 KODIAK UPPER STATION LAKE,  
FRAZER LAKE, AND AYAKULIK RIVER SOCKEYE SALMON**

FORECAST AREA: Kodiak, Upper Station Lakes

SPECIES: Sockeye Salmon, Early Run

PRELIMINARY FORECAST OF THE 1990 RUN:

	<u>Point</u>	<u>Range</u>
Total Run:	70,000	12,000 - 137,000
Escapement Goal:	50,000	50,000 - 75,000
Projected Harvest:	20,000	0 - 87,000

FORECAST METHODS:

The 1990 Upper Station forecast is the sum of individual predictions for four age classes (age 1.2, 1.3, 2.2, and 2.3). Except for age 1.2 fish every age class estimate was determined through a multiple regression equation developed from relationships of return to escapement or siblings. Each regression equation was developed to maximize the coefficient of determination and all estimates were interpreted for reasonableness. The age 1.2 predication was based on the ratio of age 1.1 and 1.2 siblings for the 1983 brood year. This relationship was chosen because the number of age 1.1 fish in 1989 most closely matched the number of age 1.1 fish for the 1983 brood year and no reasonable correlation was found in the available data sets to predict age 1.2 returns.

FORECAST DISCUSSION:

The Upper Station early run is expected to be about 70,000 sockeye salmon with 36% 4-year-old fish from the 1986 parent escapement of 101,000 fish, 40% 5-year-old fish from the 1985 parent escapement of 27,000 fish, and 24% 6-year-old fish from the 1984 parent escapement of 97,000 fish. It is reasonably probable that the 4-year-olds are underestimated since all of these are age 1.2 fish. The age 1.2 fish were estimated using the 1:4.5 ratio of age 1.1 to 1.2 fish from the 1983 brood year which is the lowest age 1.1 to age 1.2 ratio of record from 1969-85. Therefore it is likely that the age 1.2 prediction of 25,600 fish may be an under estimate.

The 1989 early run was approximately 124,000 fish which is within 8% of the preseason forecast. The 1989 escapement was about 65,000 fish. The 1990 run is projected to be about 45% fewer fish than the 1988 run.

If the 1990 run forecast is correct purse seine and gill net fishermen should harvest about 20,000 Upper Station early run fish in the Alitak Bay District by 15 July 1990.

Appendix A.7 (p 2 of 5)

FORECAST AREA: Kodiak, Upper Station Lakes

SPECIES: Sockeye Salmon, Late Run

PRELIMINARY FORECAST OF THE 1990 RUN:

	<u>Point</u>	<u>Range</u>
Total Run:	386,000	98,000 - 777,000
Escapement Goal:	175,000	150,000 - 200,000
Projected Harvest:	211,000	0 - 602,000

FORECAST METHODS:

The 1990 late run to Upper Station Lakes is the sum of five individual age class predications (age 0.2, 0.3, 1.2, 2.3, 2.2). Each age class prediction was determined through a multiple regression equation based on relationships of returns to escapements or siblings. Each equation was developed to maximize the coefficient of determination, and each estimate was interpreted for reasonableness. Individual age classes were estimated using existing count data except for one case in which a forecasted value was used to forecast another age class.

FORECAST DISCUSSION:

The 1990 late sockeye run to Upper Station Lakes is expected to be about 386,000 fish with 11% 3-year-olds, 32% 4-year-olds, and 57% 5-year-olds.

The late sockeye run to Upper Station Lakes in 1989 was approximately 707,000 fish with a catch of 485,000 fish and an escapement of 222,000 fish. The 1990 run is forecasted to be 45% fewer fish than the 1989 run.

In 1990 purse seine and gill net fishermen should harvest about 211,000 Upper Station late run fish in the Alitak Bay District if the forecast is correct.

Appendix A.7 (p 3 of 5)

FORECAST AREA: Kodiak, Frazer Lake

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF THE 1990 RUN:

	<u>Point</u>	<u>Range</u>
Total Run:	564,000	288,000 - 862,000
Escapement Goal:	170,000	140,000 - 200,000
Projected Harvest:	394,000	118,000 - 692,000

FORECAST METHODS:

The 1990 Frazer Lake forecast is the sum of individual predications for six age classes (age 1.1, 1.2, 1.3, 2.1, 2.2 and 2.3). Except for the age 1.2 estimate each age class predication was calculated by a multiple regression equation developed from relationships between returns and escapements, siblings, or smolt. Each equation was developed to maximize the coefficient of determination, and each estimate was interpreted for reasonableness. As an age class predication was made it was entered into the data base used to predict other age classes. The age 1.2 predication was estimated from the relationship of age 1.1 and 1.2 siblings for the 1979 brood year.

FORECAST DISCUSSION:

The 1990 Frazer Lake run is expected to be about 564,000 fish with 34% 4-year-olds, 26% 5-year-olds, and 40% 6-year-olds. The parent escapement for the 4-year-olds is 127,000 fish, for the 5-year-olds 485,835 fish, and for the 6-year-olds 53,524 fish. The 4-year-olds prediction is a conservative estimate and is based on the ratio of age 1.1 and age 1.2 siblings for the 1979 brood year of 1:2.7. This is the lowest age 1.1 to age 1.2 sibling ratio since 1966, the earliest brood year in our data base. This return ratio was chosen instead of the mode or mean return ratio because the age 1.1 return for 1989 was probably overestimated since the run age composition was based entirely on escapement samples and for the first time the entire catch was taken with gill nets which tend to be size selective against age 1.1 fish.

The 1990 run forecast is 47% lower than the 1989 run but 24% higher than the 1988 run. Most of the estimated 1990 run is for fish produced from the 1984 and 1986 brood year escapements which average about 90,000 fish. This is nearly the same average escapement level that produced the relatively strong 1988 and 1989 runs.

Appendix A.7 (p 4 of 5)

This is the fourth year that a forecast has been made for the Frazer Lake run. The forecast error for the last three years is high, averaging 70%. The 1987 run was over-forecasted, while the 1988 and 1989 runs were under-forecasted.

If the 1990 run materializes as predicted, purse seine and set gill net fishermen can expect to harvest about 394,000 Frazer Lake sockeye salmon in the Alitak Bay District.

Appendix A.7 (p 5 of 5)

FORECAST AREA: Kodiak, Ayakulik River

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF THE 1990 RUN:

	<u>Point</u>	<u>Range</u>
Total Run:	1,030,000	849,000 - 1,358,000
Escapement Goal:	250,000	200,000 - 300,000
Projected Harvest:	780,000	599,000 - 1,108,000

FORECAST METHODS:

The sockeye forecast is the sum of individual point estimates for seven age classes (age 1.1, 1.2, 2.1, 1.3, 2.2, 2.3, and 3.2). The exception is that the lower 80% prediction limit of the age 1.2 estimate was substituted for the point estimate for that age class. Each age class estimate was calculated by a multiple regression equation developed from relationships between returns and escapements or siblings. The equations were developed from relationships which provided the highest correlation. The forecast range is the sum of the individual 80% prediction limits for the age class estimates.

FORECAST DISCUSSION:

The 1990 Ayakulik run is expected to be about 1,030,000 fish with 1% 3-year-olds, 47% 4-year-olds, 47% 5-year-olds, and 5% 6-year-olds.

The 1990 run forecast for 1,030,060 fish is 34% higher than the 1989 run of 768,000 fish. Most of 1990 run should be produced from the 1984 and 1986 brood year escapements which averaged about 350,000 fish. This is about 20,000 fish above the average brood year escapements that produced the 1989 run.

This is the second year that a forecast has been made for the Ayakulik run. The 1989 run was over-forecasted by 25%.

If the 1990 run materializes as predicted commercial fishermen in the Kodiak Management Area should harvest about 780,000 Ayakulik sockeye salmon.

B. Alan Johnson  
Regional Biometrician

Bruce M. Barrett  
Fisheries Biologist

## APPENDIX A.8 CHIGNIK SOCKEYE SALMON

FORECAST AREA: Chignik Management Area

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF THE 1990 RUN:

<u>Early Run</u> (Black Lake stocks)	<u>Point</u>	<u>Prediction Range</u>
Escapement Goal:	400,000	
Harvest Estimate:	447,000	
Run Estimate:	847,000	645,200 to 1.05 million
<u>Late Run</u> (Chignik Lake stocks)	<u>Point</u>	<u>Prediction Range</u>
Escapement Goal:	250,000	
Harvest Estimate:	727,000	
Run Estimate:	977,000	781,600 to 1.17 million
<u>Total Chignik Run</u>	<u>Point</u>	<u>Prediction Range</u>
Escapement Goal:	650,000	
Harvest Estimate:	1.17 million	
Run Estimate:	1.82 million	1.46 to 2.18 million

### FORECAST METHODS:

The estimated run to Black Lake provided above is the summation of the predicted returns of two and three ocean sockeye while the Chignik Lake returns are calculated using all contributing age classes.

The Black Lake forecast is based on the historical relationship between the prior year total return of age 1.2 fish, the average length of prior year age 1.2 male fish and the parent year escapement. These variables provide the framework for the multiple linear regression model used to predict the 1990 run. The Chignik Lake forecast has historically been quite variable in its accuracy, and developing a model such as the one used for the first run has been unsuccessful. The forecast for 1990 was derived using an average return per spawner for each age class represented in the run.

### FORECAST DISCUSSION:

Early Run. The estimated run of Black Lake sockeye salmon in 1990 is 847,000 fish. This is approximately 643,000 less than the 1980-89 average run of 1.49 million fish. The 1985 parent year escapement was 377,500 fish, 22,500 fish below the 400,000 fish escapement goal. The weak Black Lake run in 1989 resulted in a low return of age 1.2 fish. The estimated return of 62.8 thousand age 1.2 fish in 1989 represents less than half the ten year average of 129.2 thousand. As a result, the 1990 forecast is lower than the previous ten-year average.

Appendix A.8 (p 2 of 2)

Late Run. The estimated run of second run sockeye salmon in 1990 is 977,000 fish, 103 thousand less than the 1.08 million fish average from 1980 to 1989. The second run forecast has historically been quite variable when compared to actual runs. The 1984 parent year escapement of 268,500 fish was 18,500 above the 250,000 desired escapement goal. The average return per spawner for each contributing age class was used to forecast the run and it is anticipated that the actual run will fall within the prediction bounds.

Prepared By:

Mike Thompson  
Area Management Biologist  
Chignik Area ADF&G

Jeff Fox  
Assistant Area Biologist  
Chignik Area ADF&G



## APPENDIX A.9 BRISTOL BAY SOCKEYE SALMON

FORECAST AREA: Bristol Bay

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF THE 1990 RUN:

	<u>Point</u>	<u>Range</u>
Total Run:	26.7 million	21.0 million - 34.0 million
Escapement Goal:	10.7 million	10.7 million - 14.7 million
South Peninsula Quota:	1.3 million	
Inshore Harvest:	14.7 million	9.0 million - 18.0 million

Forecasted sockeye harvests for inshore Bristol Bay fishing districts are as follows: Naknek-Kvichak, 5.8 million; Egegik, 4.6 million; Ugashik, 2.4 million; Nushagak, 1.7 million; and Togiak, 0.2 million.

### FORECAST METHODS:

The 1990 Bristol Bay forecast is the sum of individual predictions for nine river systems (Kvichak, Branch, Naknek, Egegik, Ugashik, Wood, Igushik, Nuyakuk, and Togiak) and four age classes (age-1.2, 1.3, 2.2, and 2.3 sockeye salmon). Predictions for each age class returning to a river system were calculated by averaging results from three simple linear regression models based on the relationship between returns and either spawners, siblings, or smolt. Results from each regression model were excluded from final forecast calculations if the slope of the line was not significantly different from zero ( $p < 0.25$ ) or if the independent variable was outside the range of past data. The mean return of an age class to a specific river system was used to predict returns when none of the models could be used.

Initial calculations were made with two data sets: recent data (1978-1989), and all data (1956-1989). Since the number of returning adults produced from each spawner has shown a dramatic increase since 1978, we wanted to determine whether use of recent data would provide more accurate and less biased predictions of run size. To estimate and compare forecasting errors, we made predictions for six years (1984-1989) using recent and all data. For total Bristol Bay run predictions, results indicated that use of recent data would increase accuracy (mean absolute percent error, 1984-1989: 16.9 using recent data, 36.9 using all data) and decrease bias (mean percent error, 1984-1989: -4.1 using recent data, -36.9 using all data). Unfortunately, for all river systems except Branch, Egegik and Ugashik, results strongly suggested that use of recent data would decrease accuracy and increase bias.

## Appendix A.9 (p 2 of 2)

This problem was most severe when using recent data for Nushagak and Togiak District system forecasts for which accuracy decreased more than three-fold (e.g., Wood River, mean absolute percent error, 1984-1989: 60.7 using recent data, 16.8 using all data) and a large bias towards over-forecasting was observed (e.g., Wood River, mean percent error, 1984-1989: 57.3 using recent data, -15.5 using all data). For the 1990 forecast we have tried to balance gains and losses in total Bristol Bay and individual system forecast accuracy and bias by using all data for Nushagak and Togiak District system predictions and only recent data for all other system predictions.

The mean squared error (MSE) of the total run forecast was calculated from total run predictions made for 1984-1989 and was based on the same mix of recent and all data river system models used for the 1990 forecast. The MSE was then used to estimate the standard error and 80% bounds for the 1990 total run forecast.

### FORECAST DISCUSSION:

Based on the methods described above, 26.7 million sockeye salmon are expected to return to Bristol Bay in 1990. A run of this size would be only 7% less than the previous 20 year mean (28.8 million; range, 3.5 million to 66.3 million), but 30% less than previous 10 year mean (37.9 million; range, 24.0 million to 66.3 million). Runs are expected to exceed spawning escapement goals for all systems.

The inshore harvest is expected to be 14.7 million. A harvest of this size would be only 4% less than the previous 20 year mean (15.3 million; range, 0.7 million to 37.3 million) but 34% less than the previous 10 year mean (22.4 million; range, 13.9 million to 37.3 million). An additional 1.3 million Bristol Bay sockeye salmon will be harvested during June in the Shumagin Islands and South Unimak fisheries under guidelines of the current Alaska Board of Fisheries management plan (8.3% of the total projected 15.9 million harvest).

Although out of range data were not used in calculations, they suggest how actual runs may deviate from the preseason forecast. An extremely large number of age-II smolt migrated to sea from the Kvichak and Egegik Rivers during 1987. Additionally, record numbers of age-2.2 siblings from the 1984 brood year returned to both the Egegik and Ugashik Rivers in 1989. These data indicate that age-2.3 predictions for the Kvichak, Egegik, and Ugashik Rivers could be too low, and that the actual total run in 1990 could deviate towards the upper limit of the confidence range.

Stephen M. Fried  
Research Project Leader

Beverly A. Cross  
Research Biologist  
Anchorage

## APPENDIX A.10 BRISTOL BAY, NUSHAGAK DISTRICT, CHINOOK SALMON

FORECAST AREA: Bristol Bay, Nushagak District

SPECIES: Chinook Salmon

PRELIMINARY FORECAST OF THE 1990 RUN:

	<u>Point</u>	<u>Range</u>
Total Run:	115.6 thousand	73.4 - 182.1 thousand
Escapement Goal:	75.0 thousand	
Projected Harvest:	40.6 thousand	0 - 107.1 thousand

### FORECAST METHODS:

The 1990 forecast of the chinook salmon run to Nushagak District is the sum of individual predictions for five age classes (age 1.1, 1.2, 1.3, 1.4, and 1.5 chinook salmon). The prediction for each age class was first calculated from a simple linear regression model, using natural logarithm transformed data, based on the relationship between sibling returns in succeeding years (e.g., age 1.3 returns for 1990 based on age 1.2 returns in 1989). However, predictions from regression models were used only if the slope of the line was significantly different from zero ( $p < 0.25$ ) and the independent variable was within the range of past data. If these criteria were not met, the geometric mean return of an age class was used to predict returns.

Regression models results were used to predict returns of three age classes (age 1.3, 1.4, and 1.5), while geometric means were used for the remaining two age classes (age 1.1 and 1.2). A cross-validation (Efron 1983) procedure was used to estimate forecast error and calculate approximate 80 percent confidence bounds.

### FORECAST DISCUSSION:

The forecasted run of 115.6 thousand chinook salmon would be 32% less than the long term (1967-1989) mean run of 170.2 thousand but only 6% less than the most recent five-year (1980-1989) mean run of 123.0 thousand. The projected harvest of 40.6 thousand chinook salmon would be 49% less than the long term mean harvest of 80.1 thousand but only 5% less than the most recent five year mean harvest of 42.7 thousand. The chinook salmon run to Nushagak District has been in decline since 1982. Possible causes for this trend are being investigated.

Stephen Fried  
Research Project Leader  
Anchorage

## APPENDIX B.1 A-Y-K HARVEST OUTLOOK BY AREA

### *Kuskokwim Area*

With the exception of coho salmon, projected 1990 Kuskokwim Area salmon harvests are largely based on the previous six year (1984-1989) average catches in all districts. The 1990 harvest projection range is 35,000 to 98,000 chinook salmon for the combined Kuskokwim Bay and River fisheries. Kuskokwim River coho salmon have displayed a strong odd even year cycle in recent years. The 1990 projection range for the Kuskokwim Area of 268,000 to 866,000 coho salmon is based on the even year harvests for the last ten years. The 1990 projection range for chum salmon is 212,000 to 1,463,000 fish. The projected 1990 sockeye salmon harvest range is from 54,000 to 195,000. The annual catches for all species since 1984 lie within their 1990 projected harvest range.

### *Yukon Area*

Salmon run forecasts for the Yukon River during the 1990 season are based on an evaluation of brood year run size and survival. Overall, the 1990 chinook salmon run is anticipated to be average in strength. The projected harvest for the 1990 season is expected to be average ranging from 85,000 to 107,000. Assuming average survival, it is expected that the Yukon River summer chum run for 1990 will be above average in magnitude. The commercial harvest should be similar to the 1988 and 1989 harvests ranging from 900,000 to 1,000,000 fish and 250,000 pounds of salmon roe. An average run of fall chum salmon is anticipated in 1990 which should allow about an average (pre-1986) harvest of 200,000 to 230,000. Comprehensive escapement information for coho salmon is generally lacking for the Yukon area. During 1986, escapement surveys in the Tanana River, a major spawning tributary, indicated average run strength; therefore, an average harvest of 50,000 to 75,000 is expected.

### *Norton Sound*

Run forecasts and harvest projections for the 1990 commercial salmon season are based on qualitative assessments of brood year return strength, subjective determinations of survival of eggs and juvenile fish, and projected markets for the various subdistricts. In recent years fishermen in up to half the subdistricts have been unable to find buyers for their catch. Chinook escapements for primary parent years were average to well above average; assuming relatively normal survival. The 1990 run should be above average with a harvest ranging from 9,000 to 12,000. Pink salmon should have an average run based on parent year escapements. A poor market for this species is anticipated, and commercial sales will probably not exceed 25,000. Brood years for the chum salmon run had below average chum escapement. The chum salmon run is expected to be below average. If the recent lack of buyers continues, the commercial harvests could be as low as 35,000 chums. Coho salmon runs are also expected to be slightly below average with the commercial harvest ranging from 30,000 to 40,000 salmon.

### *Kotzebue Sound Area*

The outlook for the 1990 chum salmon run and harvest is based on the comparison of returning age classes during the 1989 season. During 1990, the 4-year-old age component of the run is expected to be below average while the 5-year-olds are expected to be average. Three-year-olds are expected to be well below average. The harvest is expected to fall within the range of 200,000 to 300,000 chum salmon.

Appendix Table B.1. Preliminary projections of the 1990 A-Y-K commercial salmon harvest in thousands of fish by management area and species.

Management Area	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	Fall Chum
Kuskokwim Area						
Kuskokwim River	19-56	41-137	222-660 <sup>a</sup>	.8-11	199-1,380	
Kuskokwim Bay <sup>b</sup>	16-42	13-58	46-206 <sup>a</sup>	13-29 <sup>a</sup>	13-83	
Total	35-98	54-195	268-866	14-40	212-1,463	
Yukon Area	85-107	0	50-75	0	900-1,000 <sup>b</sup>	200-230
Norton Sound Area	9-12	0	30-40	10-25	35-150	
Kotzebue Area		0	0	0	200-300	
A-Y-K Total	129-217	54-195	348-981	24-65	1,347-2,913	200-230

<sup>a</sup> Kuskokwim Area pink and coho salmon have displayed a strong odd/even year cycle in recent years. This projection is based on the even catch for the previous 10 years.

<sup>b</sup> In addition, a projected harvest of 250,000 pounds of chum salmon roe is anticipated.

---

Because the Alaska Department of Fish and Game receives federal funding, all of its public programs and activities are operated free from discrimination on the basis of race, religion, color, national origin, age, sex, or handicap. Any person who believes he or she has been discriminated against should write to:

O.E.O.  
U.S. Department of the Interior  
Washington, D.C. 20240

---